

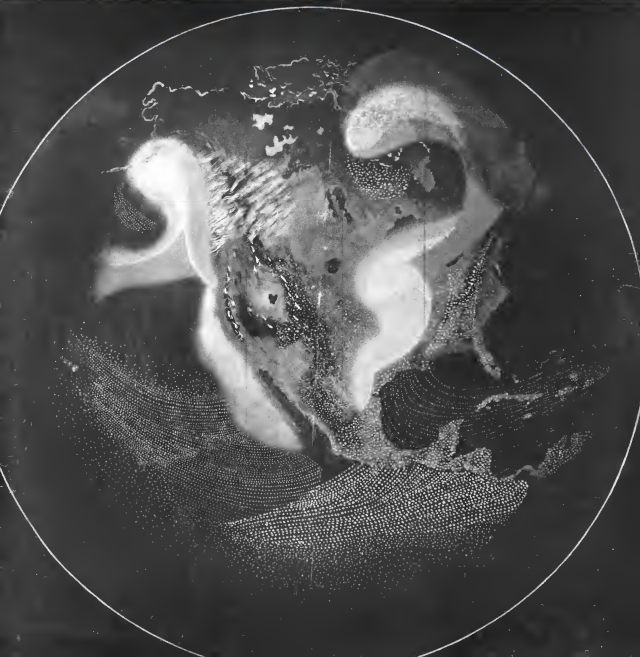
AVIATION WEEK

A MCGRAW-HILL
PUBLICATION

February 3, 1958 75 cents

X-15 Program
Probes Manned
Space Flight

TV Satellite's Weather Map



SETTING THE STANDARDS OF PROGRESS



KAYLOCK All-metal self-locking nuts®

Kaylock's revolutionary self-locking principle in aircraft nuts was the entire industry's immediate acceptance. Now the United States Patent Office also has recognized the merits of this original principle with the issuance of a patent!

Complete line of Kaylock all-metal self-locking nuts available in steel and A-286 corrosion-resistant steel for use to 1200°F.

Kaylock Nuts conform to all Air Force-Navy standards: AN365, AN364, AN365, AN366, and the new low height lightweight National Aircraft Standards.



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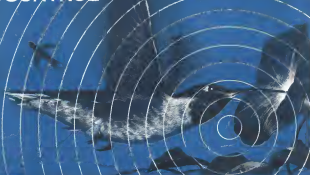
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LMEE designed F-105 flight control systems sense the effects of outside forces, correct for them with effortless deft, then human speed. Assured of stability, relieved of basic control problems, the pilot is free to make his own essential contribution to mission effectiveness. ➤ LMEE's accurate F-105 flight control system can be built into a single air warning, or as a fully automatic flight control system linked to bombing, fire control, navigation and ground control systems. ➤ Flight controls, along with many other LMEE electronic systems, help it power the peace. Write for booklet: Dept. 2P

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LARGE MILITARY ELECTRONIC EQUIPMENT DEPARTMENT
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AVIATION CALENDAR

Feb. 17-Aircraft Institute of Electrical Engineers, 1400 General Sargent Hall, Station, New York City.

Feb. 18-Eastern Service Engineers Flight Control Panel Symposium, Atlantic Hotel, Chicago, Ohio. For details: Mr. J. H. Kline, Box 942, Dayton.

Feb. 24-18th Annual Conference and Exhibit, Eastern Flight Dev. Society of the Eastern Institute, Inc., Edgewater Beach Hotel, Chicago, Ill.

Feb. 24-24th Annual Meeting for Testing Materials Committee Work, Hotel Statler, St. Louis, Mo.

Feb. 27-19th Conference of Professional Engineers, American Society of Mechanical Engineers, 1200 N. Dearborn St., Chicago, Ill. For details: Mr. J. H. Kline, Box 942, Dayton.

Feb. 27-28th Annual Meeting of the American Society of Mechanical Engineers, 1200 N. Dearborn St., Chicago, Ill. For details: Mr. J. H. Kline, Box 942, Dayton.

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RAPID ACCESS

IN ANALOG DATA REDUCTION SYSTEMS

These companion units by Hycon Eastern provide automatic indexing and high-speed access to selected data in multi-channel magnetic tape instrumentation systems.



For Tape Indexing

DIGITAL TAPING GENERATOR, MODEL 201A, generates numerically coded timing signals which are recorded on magnetic tape throughout the time recording period, providing a precise digital index in terms of elapsed time. The Generator also visually displays the exact time in hours, minutes and seconds in illuminated digits.



DIGITAL TAPING GENERATOR, MODEL 201A, FOR

ANALOG DATA REDUCTION is a self-contained unit of Model 201A, a Magnetic Tape Search Unit, and the Tape Display. Completely transistorized, Model 201A includes a battery cooled circuit system although other power sources are available to meet customer requirements. Weighing only 15 pounds, Model 201A is suitable in a port in 100,000 gauss to an accuracy of ± 1 second in 1 day's time.

For Tape Search

MAGNETIC TAPE SEARCH UNIT, MODEL 201B, operates during data reduction periods. On the basis of time indexes recorded on the tape by the Digital Taping Generator, the instrument automatically locates and selects for playback the tape data enclosed between a "sequence start time" and a "sequence end time" specified by panel dial settings. The time index is visually displayed in illuminated digits on a small separate panel which may be remotely located for convenience. Model 201B may be modified to search for timing information other than those engineered by Model 201A.



WIND TUNNEL TESTING

Process and temperature data of models are referenced to angle of attack. Model 201 records on tape in digital position along the entire angle of attack.



BY ENGINE TESTING

Digital Taping Generator Model 201 synchronizes all data recording equipment by outputting a timing signal to tape and record systems simultaneously.



WIND TUNNEL TESTING

Model 201A generates timing signals simultaneously with other tape and data Model 201 generates a timing code format for synchronization of test and recording.

Write for Technical Bulletin T3G



HYCON EASTERN, INC.

73 Cambridge Parkway

Dept. 10

Cambridge 42, Mass.

Articles with HYCON and COBART, Precision Electronics

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DIGITAL OHMMETERS



DIGITAL RATIOMETERS



**or a COMPLETE DIGITAL, MISSILE
ELECTRICAL CHECKOUT SYSTEM**

for measuring DC to 0.01%, AC to 0.1%, Ohms to 0.01 Ω , DC ratios to 0.01% and AC ratios to 0.03%

Standard, off-the-shelf modules never become obsolete—provide maximum versatility. As needs change, simply replace old modules or add new ones. Your system is always current at minimum cost and engineering. Internal construction is also modularized for ease of maintenance.

Fully instrumented chassis result in increased reliability, reduced power consumption, low heat dissipation, noninterfering packages, and eliminate radio noise and line transients.

Important new specifications—Wider, dynamic ranges cover all voltages from 200 microvolts to 1,000 volts, resistance from 30 milliohms to 10 megohms, input power frequencies from 50 to 400 cycles. New balance logic speeds down ranging. Automatic AC ranging from 30 to 10,000 cycles. Use of transistors increases switch life by a factor of three.

Wide selection of input and output modules for operating potentiometers, BNC jacks, etc., can be accommodated without modifications. All controls are accessible at rear panels with convenience. With phasing switches, digitized data is provided in printed form, parallel code or tape without modification to basic measuring instruments.



This Test Fixture Adapter gives complete specification on both front and rear panel modules. Send for it... today.

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INSTRUMENTS**

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San Diego, California

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PNEUMATIC INDUSTRIES, INC.**

*announces expansion and consolidation
of sales and application engineering services
effective February 1, 1958*

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A DIVISION OF CLEVELAND PNEUMATIC INDUSTRIES, INC.

*will provide nationwide representation for
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manufacture of the products of the following divisions:*

*The Cleveland Pneumatic Tool Company
National Water Lift Company
Special Products Division*

*The expanded application engineering staff of
AEROL ASSOCIATES offers proven know-how and
a carefully integrated service to meet the accelerating
needs of defense and industry production;*

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Lift Equipment • Test Stands • On-Site Services
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... at lower cost

Buy USS Shelby Seamless Mechanical Tubing and you've bought a built-in boring job. You can eliminate or reduce greatly the expense time and labor operations necessary with solid bar stock or forgings.

For the manufacture of hollow cylindrical parts, you won't find a more practical, economical material than Shelby Seamless Mechanical Tubing. By using it in preference to bar stock, you are able to produce a better, more uniform precision product in less time, at lower cost. Man and machine hours are reduced, rejects are fewer, and overall parts production is speeded up. What's more, even though you turn out parts by the millions, the last part will be as metallurgically sound and dimensionally accurate as the first part produced.

USS Shelby Seamless Mechanical Tubing, a product of Mechanical Tube, is available in a complete range of diameters, wall thicknesses, and steel analyses to meet the exacting requirements of every job. Let us give you a hand in selecting Shelby Seamless to your particular product.

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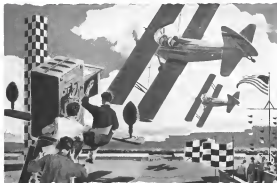
TACAN is the most advanced enroute navigation system yet developed... and Hoffman makes the complete airborne portion of the TACAN VORTAC system. Hoffman has also produced the highly efficient HLI-120 Beacon Indicator for search landing enroute TACAN VORTAC units. Other navigational equipment under development includes long range airborne radar direction finding and automatic data recording systems. In navigation, as in advanced research, development and production of military and commercial electronics, leading things continue to happen at Hoffman.

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PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA



Realism in the movies with daredevil flying

When a movie script calls for pilots and planes to re-enact daredevil flying of the early 1930's, the producers often call on Joe Pflizer. Hazardous flying of outdated aircraft is bread-and-butter work for him. Operating out of the Santa Monica Airport, in California, he and his fleet of 1930 vintage airplanes have appeared in many motion pictures based on early time flying adventures.

"Hollywood makes two strong demands when shooting a 'flyer scene,'" reports Mr. Pflizer. "Use to full power for realism and the other is minimum maintenance problems to eliminate production holdups. I get back with

Standard aviation products. Chevron Aviation Gasoline burns clean, never hinders the plane and gives me the extra power I need for movie stunt flying."

"RPM Aviation Oil keeps the aircraft in top condition and holds engine wear to a minimum. Props and valves run clean as new. I've had no engine trouble using RPM ... and so on. Kind of flying that's saying a lot."

Mr. Pflizer's fleet of 27 year old planes, the largest such group of aircraft still flying, includes restored and modified Pflizer Open biplane, Phillips Skylark, Devin DWL and a Franchell 22.

We take better care of your plane



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TIP OF THE MONTH

Avoid flying immediately below or above a cloud formation. Neither is a good place to be should another airplane suddenly pop out of the element.



Target Transponder



Missile Transponder



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Now in Production

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This precise electronic MDI features:

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3. Antennas mounted in 100 miles line of sight
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means quality instrumentation

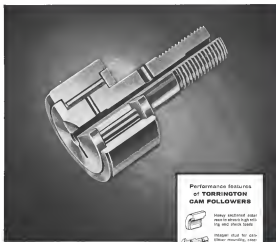
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ELECTRONICS DIVISION

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*Accuracy range			
TARGET	0-200 mile range	± 2%	
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ADJUSTABLE	The 10,000' altitude	± 2%	

*Data Results Available on Request



**Performance features
of TORRINGTON
CAM FOLLOWERS**



Heavy sectioned roller runs in smooth high rolling and shock loads.



tapered end for cam-follower mounting, non-interference with tough case for high strength in widespread shock loads.



Roller telescoped at either end or through entire hole in shaft. One economical standard drive gear, rollers or plug shafts.



Full complement of small diameter rollers for maximum roller capacity and optimum load distribution performance.



Roller precision ground for even load distribution and uniform wear and play.

Built to "FOLLOW THROUGH" under high shock loads

Every feature of the Torrington Cam Follower is designed to assure efficient performance and long service life under heavy rolling and shock loads in cam or track follower service.

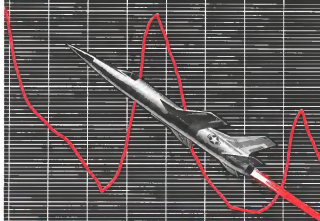
Precision made throughout, Torrington Cam Followers are available in sizes from 1/4" to 2 1/4" OD. Special surface finishes such as chrome and cadmium plate or oxide black can be provided.

Our engineering staff will be glad to work with you in applying these reliable units to your cam-controlled or track-type equipment. You can depend on Torrington Cam Followers to "follow through" on the job because every element is designed for ultimate capacity. The Torrington Company, Torrington, Conn.—and South Bend 31, Ind.

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Temperatures go sky-high, too

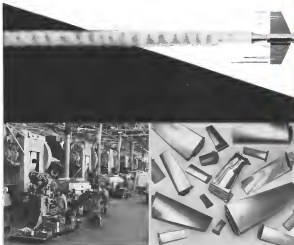
When precisely controlling the flow of fuel to the jet engine, a valve must operate smoothly in ambient temperatures see-sawing from sub-zero to torrid. Solving such problems in the age of jets makes Ex-Cell-O ideally suited for the solution of new problems. Ex-Cell-O builds high-temperature valves . . . along with blades, rotors, fuel nozzles, actuators, fuel controls, parts and assemblies.

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EX-CELL-O FOR PRECISION



Aircraft Division



Factory of forging pieces up to 4800 lbs economy produces precision parts from unusual metals at the Jet Division.



Our experience includes the precision forging of thousands of all engine components, with tolerances as close as $\pm .0003$.



Write on your company letterhead for booklet JPM321, which describes the facilities and capabilities of the Jet Division.

Precision forgings with 20-micro finish available for missiles from the Jet Division

Many parts for missile controls, power plants, and structures require the high strength of a forging. Yet complex contours and super-tough alloy structures often make finish machining slow, costly, and sometimes almost impossible.

This is the place for precision forgings made by the Jet Division. Unusual techniques and precise dies permit production of forged parts with such accurate dimensions and contours that "finish machining" generally means merely a simple polishing operation. Surfaces with 20-micro finish are being produced regularly at the Jet Division.

Alloys now being forged at the Jet Division include stainless and high alloy steels, Inconel and superalloys, as well as titanium and aluminum.

Our forging engineers will call at your convenience to discuss precision forging applications with your engineers and production men.

JET DIVISION



Thompson Products, Inc.

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- ▲ Among them, four military aircraft being equipped with the ASN-7 Automatic Navigation Computers, are the McDonnell Douglas RF-101 photo reconnaissance plane, shown above, and the F-4D-18 all-weather interceptor. In fact, by using a new world's closed circuit speed record of over 1300 mph, the Yacouba had set new transatlantic speed records. Speed and range of the Yacouba give full scope to the ASN-7's capabilities. Rhythmicometer dial and control panel (right) give pilot an indication of where they are, their ground track, and the course and distance to their destination and to other key destinations.



G-E 5-Star Tubes give added dependability to Ford Instrument ASN-7 Automatic Navigation Computers!

General Electric 5-Star high-reliability tubes—Types 9902, 6111, and 6112—help make the new ASN-7 course and distance computer a more accurate continuous-time navigation system.

The ASN-7 was designed and built by the Ford Instrument Company division of Sperry Rand Corporation, under the direction of Wright Air Development Center. Simplicity of operation, plus a continuous feed-in of wind and magnetic variation, allows the system to serve as a dependable navigation

system, from takeoff through mission to final landing.

These compact, two amplifiers, a dual indicator, and a control console make up the complete ASN-7. Tubes were preferred to higher standards. "We found that General Electric tubes met our requirements for reliability, ruggedness, and size," affirms Ford Instrument engineers.

The same 5-Star Tube qualities are available to your circuit designers. Write or phone the nearest office of the G-E Receiving Tube Department below!

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Los Angeles 24, California
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WHO'S WHERE

In the Front Office

The following officers of the new trans-geo. aerospace firm (which just overtook Jap of North American Aviation, but was Philip Perle's Co.) have been named: J. L. Arnold, president; R. M. Thomas, vice president; R. A. Lindholm, treasurer; Paul J. Fisher, secretary. Mr. Arnold is president of North American, and Mr. Thomas is Philip's vice president for research and development. Joint staffs of the two companies were elected directors, from North American: Morton Arnold, Lindholm, J. S. Staehlin and S. K. Helms, from Philip Perle: Earl E. Roth, Stanley, Leonard, W. W. Koster and Mr. Thomas.

Donald H. Friesen, president; G. M. Gossens & Co., Inc., President; Gold D. Franklin E. Lawrence, vice president-engineering; Claudio D'Amico, Area Manufacturing Corp., Cincinnati; Chas. D. Lawrence, president; C. J. Fels, vice president-manufacturing.

Dr. Theodore K. Strick, vice president research and engineering; Robert Knapp and Development Laboratories, Inc., Woodville, N. Y.

John A. Shuler, vice president-translator; The Ramo-Wadsworth Corp., Los Angeles, Calif.

Richard N. Goltzsch, vice president-research; Semiconductors Division, Raytheon Corp., Everett, Mass.

Gene Wolfen, vice president and general manager; Pacific Instruments Corp., Lafayette, Calif.

Dr. Richard H. Judson, Assistant Technical Director in charge of Operations Air Chief, American Vintages, Inc., Washington, D. C.

Honors and Elections

Dr. Karl H. Hohenhausen, chief mechanical engineer, Helicopter Division, McDonnell Aircraft Corp. was selected as the first recipient of the annual General Electric Award for outstanding work in the field of helicopter development.

Changes

Dr. Albert G. Hall, director of research, The Martin Co. Schenectady, N.Y. Dr. Hall's headquarters will be at the Denver Division, but he will continue his technical activities on the Trans-geo project.

Neil E. Pearson, general manager, the Denver Region (Department of Aeronautics), General Electric Co., Cincinnati, Ohio.

Edward M. Page, manager new construction, Machine and Ordnance Section, Department, General Electric Co., Philadelphia, Pa.

F. A. Bledsoe, Jr., supervisor performance design and test, W. R. Bell, supervisor optical analysis, General Electric Division of General Dynamics Corp., San Diego, Calif. Also Dr. C. M. Warlick, assistant in the chief planning for administration in the field of space nuclear research (Continued on p. 107)

INDUSTRY OBSERVER

▶ Recent rapid progress in solid propellant development probably means limited production sales for the liquid-propellant Thor and Jupiter rockets in the near future. Navy estimates that the Air Force will have an extensive penetration of progress with its solid-propellant Thor (SRM). Under new Department of Defense planning, both the Thor and Jupiter will be produced for Air Force on a single-shift basis.

▶ Navy believes recent breakthrough in Polaris first ballistic missile program will bring the 1,500-mile missile into the inventory even before its new 1960 target date. Original target date was 1955. If Polaris is ready before the new target date, initial quantities probably will go almost entirely ships since the first of its deliveries isn't scheduled for completion until 1960. In the push to accelerate Polaris, Army-Corps's Solid Rocket Boost, which is developing the solid-propellant propulsion system, has expended time at a cost of five in 1956 to a present working force of over 500.

▶ Air Force estimates average direct cost of an Atlas-type intercontinental ballistic missile to be in the neighborhood of \$200 million. Total cost of missile, including test operations and training, will be more than doubled. "SRM" was direct cost of the first operational intercontinental stage ballistic missile program should run approximately \$14 million.

▶ Douglas G-46B II air-liner model with a nuclear reactor was being developed in operational tests at the Air Force's Nevada test site last July. First Genie was placed into Defense Command's Nevada inventory in January, 1957.

▶ Bell Aircraft air-to-ground missile is scheduled to become fully operational with the Strategic Air Command in April.

▶ Fiat G-97B two-seater trainer developed from the NATO light tactical strike fighter, probably will get approval for production from the Italian government. Negotiations are under way to build an initial quantity of 30 aircraft.

▶ Fiat West Coast SAGE facility, including both direction and combat centers, is scheduled for completion before June 1. Facility is located at McChord AFB, Wash.

▶ Sixteen Division of United Aircraft, which has mounted outside the light helicopter business field during the last few years, may get back in again with the S-55. The drone may take back a maximum of 10 from five percent contracts, maintenance and other items for resale. Changes being contemplated include an improved rotor system or a Westland Widgeon type rotor.

▶ First two Avco GT-101 Arrow microphones will be built under present Royal Canadian Air Force plans. The Canadian program, similar to USAF's Ford-Corpus plus, calls for a long initial order of aircraft to accelerate the test program. Aircraft will be built on production tooling so that needed changes can be made quickly and operational aircraft produced on a minimum amount of time.

▶ An air intake version of P-350 155 (long) has been ordered in a prototype by the Italian government. The two-engine aircraft features a high length (160 ft) will be powered by Pratt & Whitney RB250 turbo-prop engines.

▶ Army is looking to determine full potential of its Nike Zeus anti-missile missile through static model tests at Bell Telephone Laboratories, Whippany, N. J. Specimens are that in tests that for "no have gotten" were destroyed in a series of tests. The system is being tested in the weapons of the Zeus in order to be Douglas Aircraft's Santa Monica, Calif., plant.



Ski-Jump with Jet Assist

A new version of the Fairchild C-123 is now flying with the USAF. Its wheel-to-tilt combination gear enables it to operate from ice or snow-covered fields as effectively as from unpaved dirt strips.

Takeoff performance shoots up with the addition of a Fairchild 244 jet engine at each wing tip. Substantial increases in payload have become possible—takeoff and landing weights over 60,000 lbs. have been achieved and will become routine.

The ski-and-jet C-123 is typical of the versatile development and the potential Fairchild builds into its aircraft.

FAIRCHILD
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 —WE BUILT THE FUTURE IN RESEARCH AND LIGHT PLANE—

Washington Roundup

IRBM for Army?

Watch for Army to move quickly back into the intercontinental range ballistic missile field. Former Defense Secretary Charles S. Wilson earlier pushed a 200-mile range limit on Army missiles already has been allowed to make way for the Pentagon, a solid-propellant version of the Redstone which probably will have a range of approximately 500 mi. The new missile, agreed by Wilson's successors, Neil McElroy, gives the Army license to farther extend the range through advances in the state of the art so long as the missile meets the range falls within its tactical requirements. Army Secretary Wilbur Bruchman considers 1,500 mi. self-defense tactical requirements.

Bilateral Limbo

Negotiations between the State Department and foreign governments on such as transport agreements are in limbo. Pending talks with France, Belgium and the Scandinavian countries with no specific date set for resumption. Although Russia and the U.S. have agreed "in principle" to an exchange of notes, no date has been set for a conference to work out detailed terms and conditions.

Yet to come are talks with Japan and the Philip-
 pines, probably late in the spring or early summer.

Final Conclusions

Findings and conclusions of the Senate Preparedness Subcommittee released by Sen. Lister Hill, Johnson (D-Tenn.) are not the first thorough appraisal of U.S. defense and technological advances as compared with Russia.

About one year ago, a special Air Force Subcommittee headed by Stuart Symington (D-Mo.) released a report that contained a similar listing of deficiencies with an appeal that they be corrected as promptly as possible.

Features of the 17 recommendations as well as five of the findings, made by the Johnson Subcommittee, were announced in Symington's August Report. The Johnson Subcommittee recommendations not covered in the August Report were the exchange of scientific and technical information, the question of stockpiles and shelters for civil defense and waste effort in the development of manned aircraft.

The only additional finding in the Preparedness report was that the Soviet Union had led the world into outer space, a fact that was not a novelty at the time of Symington's report.

Although the two reports are one similar, sessions to the two are not.

Following the Symington report last year, those developments took place:

- Production schedules of the Boeing B-52 were cut back from 20 to 45 monthly per month
- Production schedules of the Boeing KC-135 jet tanker were cut from 20 to 15 per month
- Defense Department directive cut \$170 million from support of research and development
- Cutting was placed on defense expenditures for fiscal 1975
- Funds for the development of an atomic aircraft were cut

Following the appearance of the Soviet Union's Sputnik and the beginning of the Johnson Subcommittee investigation, these events took place:

- President Eisenhower showed a personal attitude in recognizing the Defense Department and a committee was appointed in Defense Secretary Neil McElroy to recommend changes
- Production of Thor and Jupiter intermediate range ballistic missiles was authorized and development of Atlas intercontinental ballistic missiles and Polaris fleet ballistic missiles was accelerated
- Basic research projects were returned to former levels
- Overtime restrictions were removed from ballistic program and some of the other Defense Department high priority programs
- Satellite programs were accelerated
- Early warning system and early missile missile programs were accelerated

Defense Reorganization

Administration's proposals for reorganization of the Defense Department will not reach Congress before the end of March, is Secretary Neil McElroy's assistant. Reorganization is expected to give McElroy more direct authority over specific military programs as well as greater control over funds.

Group named by McElroy to help him with the reorganizing those is supposed to gather the views of service secretaries and chiefs of staff and others, and report to him and study. McElroy will then refer the conclusions to the President. Johnson's Mr. William G. Foster, member of the Graham Committee (AWC Dec. 2, p. 73) and former Deputy Defense Secretary, Nicholas A. Rodichoff, chairman of the President's Johnson Committee on Government Reorganization and contributor to the Rockefeller report (AWC Jan. 11, p. 34), Anne G. Conn (N. Atlantic) and Adm. Arthur W. Radford, senior chairman of the Joint Chiefs of Staff, USAF, Gen. Nathan I. Twining, former JCS chairman, and Charles A. Goodrich, former Assistant Defense Secretary and author of the Goodrich report on classification of defense information, as full-time special assistant.

Budget Scientists

More target of scientific leaders testifying on Capitol Hill on the need for expanded scientific and technological programs is the status of the Defense Department of Defense is making a close second. Dr. L. V. Berkner, president of Associated Universities, pointed that since the end of World War II, the Budget Bureau has reported only "very cautious" estimates on the total basic science projects. For example, he said, funds for the world's seventh program of the National Research Laboratory, were cut off twice. Instead of the present practice of "reducing cuts" in budget and accounting officers, he said, such projects should be periodically reviewed and weighed in scientific groups.

If the view does, Berkner estimated that "millions of dollars could be saved."

Scientists must criticize of Defense Department as its record of development of basic research and its acceptance of engineering development.

Believe without it that Defense Department's total basic research effort now amounts to only about \$30 million a year.

—Washington Staff

How X-15 Will Double Man's Mach Number

Inertial navigation system, thick blunt trailing edges are aids to exploration of new flight regime.

Washington—X-15 rocket research aircraft, descendant of manned orbital bomber, is a 50 ft long cylindrical flying fuel tank with small, movable control surfaces, an inertial navigation system and a potential for altitude capabilities that take stage as high as 100,000 ft.

Porting an unusual number of automatic aids to the tail behind the wings of the X-15, still requires manual control. It will take some the future of manned aircraft while it explores heating and re-entry problems.

Longer Range

X-15's range is more than a half that of the X-1 and X-2—400 statute miles versus 100. Duration of powered flight is closer to that of the earlier research rocket—about 30 minutes.

Usual feature of the vertical air surfaces is the extremely blunt trailing edge, measuring 12 in. across. Vertical surfaces are a vital part that is jettisoned on landing, and to appear vertical for about two portion miles at the control surfaces do in the future reentry mode.

Modification of the X-15, with heavier added, probably, contributes North American Aviation's entry in Air Research and Development Com-

mand's Rocket Orbital Bomber (Rabob) competition, which closed last August.

Rabob specifications were very general but extremely high speed, far beyond X-15's Mach 5.7 range, was called for. Speeds may have been too to share those of the X-15.

Both manned and unmanned versions and ballistic and glider, rocket launchers, were proposed for the Rabob competition. Unmanned version probably for reconnaissance work, would be clock table, referred as optical scanning device, with provision for relaying their intelligence to ground stations.

Competitors included at least five companies—North American Aviation, Inc., Boeing Airplane Co., and Bell Aircraft Corp., whose studies were accepted by USAF and Douglas Aircraft Co., Inc. and Republic Aviation Corp. Maximum gross weight of the X-15 is some 52,000-53,000 lb. Structure is primarily steel. Those copies will be built. Throat of the single barrel engine is about 60,000 lb. at maximum thrust.

X-15's fuselage is integral tailage forming a constant section body of 20 in. diameter at 27 ft in 50 ft. length. Diameter is 4 ft. at tail. Two oblong wings for fuel and oxygen contain fuel for shaped like radar dishes facing forward to control surge and center of gravity. Tube 12 in. in diameter runs

the full length of both tanks, probably serving as a structural member as well as a fuel line.

Propellers probably will be solid, driven ammonia and liquid oxygen. Kerosene will not be used.

Third track for gas generator fuel, is spherical in shape and heated air of oblong tanks.

Two very large bulges of greatly irregular shape, begin on the side of the X-15 fuselage just behind the wings. Each terminates at the aft end of the fuselage in a large blunt in angular base. The wings extend from the fuselage through these bulges. The primary purpose of this arrangement in usual configuration is to measure in interference drag between the fuselage and the wing, which can become particularly at X-15 speeds without out full design.

These bulges also contain all heat, controls, wires, plumbing, control air face, oxygen, etc., and are made of beryllium to rank heat.

Wing leading edges are sharp but not as sharp as those of the F-104. Trailing edges are blunt, sweeping from 21 in. thick at root to 1 in. at tip. All corners are rounded to smooth aerodynamic.

Wings have small, deep chord upper-surface airfoils located approximately in mid wing.

Horizontal Stabilizers

Horizontal stabilizers, approximately 4 ft. long have 15 degree dihedral.

Upper vertical control surface is approximately 3 ft. high. While upper half extends for reconnaissance view control.

The leading edge is swept back 40 deg. from the vertical and trailing edge, has 5 deg. forward sweep. Vertical fin, about 4 ft. long, jettisoned on landing. Both have leading edges 1 ft. wide.

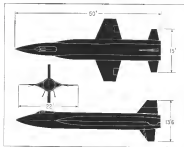
For reaction ports 35 in. in diameter for full control at extreme altitudes are located 30 in. forward of wing and 2 ft. behind and are devoted upward.

Push and pull control rockets are located in the same at top and bottom of fuselage. Capt. John C. Kucukowicz indicated to be the first USAF pilot to fly the X-15, and it has not been dropped yet whether the rockets are capable of fine enough control rate presently or whether it will be necessary to jettison those against one as effort to get free control from the difference is lost.

Joseph A. Walker, staff National Advisory Committee for Aeronautics pilot scheduled to fly the aircraft and its pilot will handle the control rockets.



ARTIST'S conception of North American X-15 shows stubby wings, long window for side window.



ARTIST'S conception of X-15. Note side view at left center.

quite directly without the interpretation of many black boxes between him and the pilot has position in all three direct ways.

But X-15 is now flying with reaction controls to give more data on control techniques.

X-15 does not have enough room for air and pitch rockets in the nose, and they are limited checkers.

Altitude control rockets in the X-15 are fueled by high test peroxide, a nonpollutant generating thrust in its decomposition when set off by a chemical catalyst.

Because high altitudes destroy the usefulness of pitot-static instruments such as altimeter and air speed, and because advance speed limits the accel-

erates of other instruments, the pressure measurement system is manual, letting the pilot his position in all three direct ways.

NACA-developed new instruments too is contained in a 6-in. diameter hemisphere and holds small functions of a nose boom. An altimeter now has the standard boom. Nose of the cockpit is made of glass but side windows is located in two small windows.

Landing gear is two wheels which pop out of bladders on the sides of the aft part of the fuselage.

This type was chosen to save weight, and because of the availability of the dry lake at Edwards Air Force Base for landing.

X-15 will be fitted to 50,000 or 40,000 ft. is a modified B-52 bomb.

In each flight at least X-15 probably will start at Wendover Air Base, Utah, and end at Edwards Air Force Base, California. Very complete tracking and telemetry equipment is being installed along the route.

Soft flats near Wendover and along the route also provide emergency landing sites.

NACA is flying the X-1 and X-15 as a week, schedule to show the up-coming to be, and in the X-15.

Reentry is expected to be the biggest problem in the X-15's flight. That will be to come into the atmosphere it

NACA Urges National Space Program

By Evert Clark

Washington—National Academy Committee for Aerospace reported that a comprehensive study of space flight programs is expected to gain wide industry, military and scientific support. Its success will depend upon its acceptance in Congress, where several such flying plans already have been proposed.

NACA's plan also appears to have strong backing in its parts of the executive branch of the government.

Essence of the proposal is that "a series of coordinated national effort" must begin immediately making maximum use of existing agencies and facilities and creating others as well as utilizing aspects of space concept.

Largely parallel to the future is the new federal responsibility for NACA in its manned, robotic, military, the science and the military services over the past 40 years.

National Science Foundation and the National Academy of Sciences must plan scientific experiments, assign priorities for basic research in space phenomena.

National Science Foundation also would provide financial support for research in the detailed planning, design and construction of special apparatus, related research and control of data for approved projects.

NACA Role

NACA would conduct flight tests, scientific projects by itself when it could or jointly with agencies of the Defense Department, as in its own research aircraft program.

It also would coordinate and conduct research in space technology as its own laboratories and be contract in support of both military and non-military projects.

This would require "a rapid expansion" of NACA's staff, conduct research programs and existing laboratories and construction of new facilities including a launching site and a network of observation stations.

The National Mission Committee for Astronautics itself unanimously adopted a resolution last June 15 calling forth the program and stating that the support of an adequate national program of research and development leading to manned satellites, lunar and interplanetary flight is now apparent.

Outlining the program to the first three of Astronautics Sciences in New York last week, NACA's Director Hugh L. Dryden said in a speech delivered by NACA President Stephen D. Parker that the committee "has been

engaged seriously in a search for light to the problems of space flight" since the end of World War II.

In addition to the NACA rocket research activity, he said, NACA is "engaged in studies of satellite configurations suitable for use in earth or still higher orbits both for manned and unmanned flight."

But the present program is far from adequate. Dryden said, "One side of progress in solving the problems of space flight must be our growth in research."

Doolittle's Warning

Dr. James H. Doolittle, NACA chairman, said in a letter to Congressmen that he said before Russia reached their first Sputnik—that the present government concern—coupled with the effect of rising costs—has resulted in the general level of NACA research effort compared to that of the Soviet being lowered when it should be increasing.

There is no question that American research in astronautics has been deteriorating. There is no urgent need at this time for a general increase in the level of research effort.

Dr. Dryden told Congress last year that NACA's 25 technical committees had sought a 25% increase in effort and that a budget request had been prepared accordingly. But he said, the Budget Bureau has not \$20.5 million from the \$148 million request and denied NACA's supplemental budget request in full for the first time in 1955.

But the present program is far from adequate. Dryden said, "One side of progress in solving the problems of space flight must be our growth in research."

Major Research Fields

NACA listed three major research fields a body must be more thoroughly explored:

- Space mechanics.
- Space environment.
- Cosmic sources.
- Population systems.
- Materials.
- Launch, rendezvous, recovery and recovery.
- Communications, navigation and guidance.
- Vehicle configuration and structure.

NACA Space Committee

Washington—Members named this for the Special Committee on Space Technology of the National Academy Committee for Astronautics (NAS) Jan. 15, 1955 are:

- Dr. H. G. Storer, member, dean of engineering, Massachusetts Institute of Technology.
- Dr. John A. Allen, NACA Scientific Advisor.
- Dr. John A. Allen, NACA Scientific Advisor.
- Dr. Joseph W. Bode, director of mathematical research, Bell Telephone Laboratories.
- Dr. Milton U. Gerson, director of aeromedical laboratory, Naval Medical Research and Development Command.
- Prof. Dale K. Cram, Cornell University.
- Joseph B. Duggan, manager, Convair Astronautics Division, General Dynamics Corp.
- Robert K. Thompson, assistant director, Langley Aeronautical Laboratory, NACA.
- S. K. Shuman, general manager, Rocketdyne Division, North American Aviation, Inc.
- Dr. W. Randolph Lovelace II, Lovelace Foundation for Medical Education Research.
- Dr. William H. Pickering, director, Jet Propulsion Laboratory, California Institute of Technology.
- Dr. Leon N. Ridenour, Jr., Missile Systems Division, Lockheed Aircraft Corp.
- Air Force, associate director, Langley Flight Propulsion Laboratory, NACA.
- Dr. James A. Van Allen, director of Physics State University of Iowa.
- Dr. Winston W. Eaton, director, Development Operations Division, Army Research Office, Dayton, Ohio.

- Space biology.
- Flight simulators.
- Measurement and observation techniques.

NACA's program apparently would not conflict with Defense Department's Advanced Research Projects Agency, based on what is now known as ARPA's

projected program. It might, however, limit the need for ARPA to become an operating agency since it seems to achieve financing out of its own space research and development as possible to the military, NACA industry and academic institutions.

Conflicting proposals have called for new, independent government agencies to perform either the civilian or military and military aspects of research and development for space, handling of the work in the Atomic Energy Commission creation of a whole Department of Science, etc.

Development in industry and the military with the vigorous support of the Department's plans for ARPA and the military support finding that existing agencies must be used in some or not wanted in the formation of new ones would indicate that NACA's proposed might find more support than any other specific program outlined so far.

Membership of the committee (see box, p. 12) which adopted the space age resolution unanimously, also indicated wide acceptance in government, industry and scientific circles.

But the congressional letter has cost of whatever becomes the nation's "space agency" promises to be a critical factor in the future of NACA's proposal.

Senate Group Asks White House Action

By Fred Eastman

Washington—Senate, Pre-conditions Subcommittee members and staff said it will go to the White House and Defense Department to take action on the 17 recommendations it proposed to bring the nation's defense.

Subcommittee members and staff say they will strongly seek to lead administration in pushing one legislative proposal to implement the various proposals.

Interim Report

The recommendations were contained in an interim report issued on the conclusion of the subcommittee's investigation into the U. S. satellite and missile, but behind the Soviet Union, a more detailed report is expected to be ready within a few weeks.

Sen. Lyndon Johnson (D-Texas) subcommittee chairman reported that, during the hearings, more than 70 witnesses appeared and about 200 experts were interviewed.

Most of the recommendations and findings were made last year by the Senate Subcommittee on the Air Force but received little public attention in the press.

The 17 areas upon which the subcommittee and "defense" action must be taken.

- Moderate and strengthen the Strategic Air Force.
- Accelerate the disposal of SAC forces.
- Put more effort into developing anti-missile weapons.
- Improve the early warning system for manned aircraft and accelerate the development of an early warning detection system for ballistic missiles.
- Moderate and strengthen ground and air forces.
- Provide an adequate staff for ground troops.
- Put more effort into the anti-air warfare program.
- Accelerate production schedules of Atlas, Titan, Jupiter and the development of Titan.
- Reduce lead time in the development of weapons to new missiles.
- Increase size and strengthen present personnel.
- Provide for a free exchange of scientific and technical information between the nations of the free world.
- Increase immediate development of a 1,000,000 lb thrust rocket motor.
- Give serious attention to the question of efficient and adequate for civil defense.
- Reorganize the structure of the defense establishment.
- Provide increased incentives for the reduction of burden personnel in the military services.

- Accelerate and expand research and development programs provide funding on a long-term basis and ensure continued development within the Department of Defense or through the establishment of an independent agency.
- Put more effort into the development of anti-missile weapons.
- Accelerate the development of the Polaris missile system.

Sen. Johnson explained that the subcommittee's responsibilities are limited to defense, but that the U. S. has reached a stage where defense needs the largest effort of a nation. He said the subcommittee was led into fields that will have to be explored more fully in order with proper protection and with greater background.

Unanimous Vote

The proposal itself is the conclusion of the hearings was adopted by a unanimous vote of all subcommittee members.

"There is nothing in the record," the report said, "to indicate that America has lost its stability or its capacity to produce in times whatever we need to retain our present power to strike those nations identified with against total destruction—it is apparent."

It added that there is evidence that the Russian satellites, although not regions now, have two important in-

Backers of NACA Plan

Washington—Members of the National Academy Committee for Astronautics who unanimously approved the Jan. 15 resolution calling for a national space flight program were:

- Dr. James H. Doolittle, chairman of NACA and the USAF Scientific Advisory Board and vice president, Shell Oil Co.
- Dr. Arnold Compton, NACA vice chairman and secretary of the Smithsonian Institution.
- Thomas B. Bennett, associate vice president of Space Research Corp.
- Dr. Debra W. Bunk, president of the National Academy of Sciences and National Research Council, chairman of the National Science Board, member, President's Committee on Scientific Information.
- Dr. John A. Allen, NACA, Jr., deputy chief of naval operations.
- Dr. Paul D. Rorty, Assistant Secretary of Defense for Research and Engineering.
- Roy Allen, Washington U. House, member chief of the Bureau of Aeronautics in government.
- Dr. James C. Houder, professor emeritus of astronautics engineering, Massachusetts Institute of Technology, Board of Regents, Smithsonian Institution, and former chairman of NACA.
- Charles J. McCarthy, chairman of the Joint Chiefs of Staff.
- Dr. Guy Donald L. Pitt, USAF deputy chief of staff for development, military director, USAF Scientific Advisory Board.
- James T. Pitt, Civil Aeronautics Administration.
- Louis S. Brinkley, director of Research in Transportation studies, Veterans Administration Board.
- NACA members about whom the resolution was approved.
- Dr. Allen V. Vane, director of the National Bureau of Standards, secretary of the Departmental Committee on Scientific Research and Development.
- Robert C. Connelley, chairman of the Joint Transportation Board.
- Dr. Thomas W. Ridenour, chief of the U. S. Weather Bureau, member of the International Committee on Scientific Research and Development.
- Edward V. Ridenour, chairman of the Joint Chiefs of Staff.
- Guy Donald L. Pitt, USAF deputy chief of staff.

platforms. They demonstrate beyond question that the Soviet Union has the propulsion drive needed to send a missile from one continent to another, and the Soviet Union has gathered basic information about outer space.

In an enlightening, questions raised by these facts, the report said testimony of top scientists, leading industry officials, government and military officials, cited:

- That the Soviet Union leads the U.S. in development of ballistic missiles.
- That the Soviet Union leads the U.S. in the number of submarines, which raise the possibility of attack with nuclear weapons or missiles although indications are that the U.S. is ahead in the production of atom-powered submarines.
- That Russia is rapidly closing the gap in missile systems and, at present, may well surpass this country as a superpower's chief foe.
- That Russia is producing satellites and technicians at a rate substantially greater than our country.

U.S. Reaction

The report said that since Sputnik 3 was put into orbit on Oct. 4, the Defense Department has taken the following action:

- Overhauled instructions have been received from ballistic missile programs and some other high priority programs.
- Basic research projects have been shifted to former levels.
- Areas have been ordered into the missile program.
- Production of the Thor and Jupiter intermediate-range ballistic missile has been accelerated.
- Development of the Atlas intermediate-range ballistic missile has been accelerated.
- Development of Navy's Polaris ballistic missile system has been accelerated.
- Areas has tented a goalpost for developing a solid propellant tactical missile the Fording.
- An Advanced Research Project Agency has been authorized by Defense Secretary Neil McElroy to examine space and sub-orbital projects.
- An Office of Director of Global Missions is being.
- Development of anti-submarine warfare capability has been emphasized.
- Steps to improve SAC air order now go ahead with its long-range missile defense system.
- Areas has been assigned the task of developing an anti-missile missile.
- Secretary of Defense has appointed consultants and promised to come to Congress as soon as possible with recommendations to improve the defense establishment through organizational changes.

German Defense Minister to See McElroy on Aircraft, Arms Choice

Bonn—West German Defense Minister Franz Josef Strauss flies to the U.S. on May 11 for a two week information tour.

He will be the guest of U.S. Defense Secretary Neil McElroy.

Object of Strauss' trip will be to check on planes, tanks and other equipment for German's military forces and to review defense problems. Questions of obtaining IRBM's on German soil are not on the agenda but undoubtedly will be discussed at least informally. A decision as to where to put IRBM's in Europe is expected at a NATO defense ministers' meeting toward the end of March.

Biggest government plan still pending is a decision on an advanced reconnaissance for the German air force. The Lockheed F-104A and the Grumman F119F are still front runners, but the field which has recently narrowed to three, has been widened again to include the Chase Yankee F102-1, France's English Electric F1B which is being built from this week in a German town, Sweden's SAAB 35, followed by the German but now slated for a trial, and Northrop's N156F.

May Test SAAB

A mission may be sent to Sweden to test the SAAB following reported requests from Stockholm.

However, chances for an order to a non-NATO country are regarded as slim to none.

Only the Saunders Roe SR 177 has been matched outright as rival of the English firm's demand for "yes" or "no."

Absence of a clear-cut American position on an advanced reconnaissance, not precise, is thought by the British after German rejection of the Saunders-Roe SR 177, is a major problem for the Germans in reaching a decision, U.S. military officials here believe.

A team of German air force experts headed by Chief of Staff Lt. Gen. Josef

Kunze has been to Washington on Feb. 7 for technical talks aimed at clarifying a number of aircraft cooperation claims and counter-claims. Although the number of planes to be bought has varied from 100 odd to 400, value of the contract will easily top \$100 million.

Merit to Count

Defense Ministry officials insist decisions will be based mainly on merit but political considerations have played a part in delaying placement of anti-aircraft weapons.

Both English and France are anxious to finish their foreign currency accounts, and American manufacturers would like to recoup from 1957 USAF contracts only and cancellations.

Entrustment decisions, which was originally slated prior to Dec. 31, then postponed until this month seem unlikely before the end of March.

Germans are now using prospective suppliers for additional technical data as well as reviewing flight data submitted to date.

Northrop Reveals T-38 Fighter Details

Northrop N156F fighter is based on the T-38 reconnaissance, is scheduled to have a range of more than 1,500 nautical miles with a 45-minute turn.

Cost will be \$11,500 per aircraft with 10,500 lbs. for the basic version, wing span is 35 ft 5 in., with a 7 ft 10 in. height.

The overall length is 41 ft 7 in. to 42 ft 8 in. for the T-38. Height is 15 ft 11 in. compared with 11 ft 11 in. for the T-38.

In addition to bomber, fighter, and the N156F will have air to air combat loading eight missiles. A dogfight will be used to shorten the landing run.

Adverse and under test will be in field to control from feet. Longitudinal feel will be in combination of control from wing and tailhook. Longitudinal and directional stability augmentation will be used in areas with control systems.

Speed brakes will be located on an airframe of fuselage forward of main landing gear doors.

Skid surface with Teflon will supplement crossers, they for operation from soft runways. Skid is painted to serve the same function as the skid wheel stabilizers at reduced weight and volume for saving.



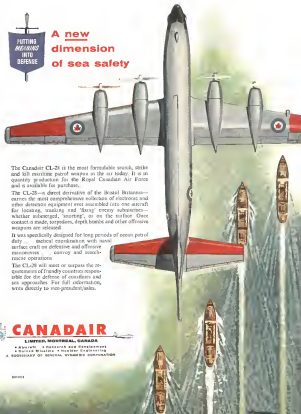
GLOBAL GUARDIAN—Newbie can on mission take refuge from America's mighty instrument of retaliation, the Northrop Snark SM-60.

world's first intercontinental guided missile, now scheduled for delivery to the Strategic Air Command of the U.S. Air Force. These platform busters are designed to carry nuclear warheads with steering accuracy over intercontinental ranges. Snark missiles can be launched in mass from sites thousands of miles from their targets. This forceful deterrent to attack is an evasive product of Northrop's "years ahead" engineering. Missiles, drones, supersonic jet aircraft, ground support and electronic equipment, integrated weapon systems and other vital national defense elements are being developed and produced at Northrop, where simplicity and economy are vital elements in the continuing search for weapon systems to guard tomorrow's free America.





A new dimension of sea safety



The Canadair CL-25 is the most formidable search, strike and lift maritime patrol weapon in the air today. It is in quantity production for the Royal Canadian Air Force and is available for purchase.

The CL-25—a direct derivative of the Bristol Britannia—carries the most comprehensive collection of electronic and other defense equipment ever assembled into one aircraft. For locating, tracking and "bluing" enemy submarines, whether submerged, "surfing," or on the surface. Once contact is made, torpedoes, depth bombs and other offensive weapons are released.

It was specifically designed for long periods of ocean patrol duty — tactical coordination with naval surface craft on defensive and offensive missions — convoy and search-and-rescue operations.

The CL-25 will meet or surpass the requirements of friendly countries responsible for the defense of coasts and sea approaches. For full information, write directly to vice-president/sales.

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Congress Draws Battle Lines For Outer-Space Control

Washington—A three-way fight over political and administrative control of outer-space research and development has developed among leaders in Capitol Hill.

On one point all three factions concur: control should be with a civilian agency. They would pull power out from under the Advanced Research Projects Agency which Secretary of Defense Neil McMillen proposes to establish to give military direction to outer-space development (AW Jan. 27, p. 12).

Three Proposals

The three proposals, each with powerful backing are:

- **Establishment of a Department of Science and Technology**, headed by a cabinet-level Secretary, who would give policy direction to all civilian scientific functions. This legislation is sponsored by Sen. John McClellan (D-Ark.), chairman of the Senate Committee on Government Operations and permanent chairman, and by Sen. Robert Humphrey (D-Minn.), chairman of the subcommittee on transportation.

- **Establishment of a five-member presidentially-appointed National Science Council** to direct outer-space and all other specific projects of the general outer-space and nuclear. The position of Rep. John McCormack (D-Mass.), House majority leader, who introduced and is pushing this measure is that a new Department and Secretary of Science and Technology would simply waste scarce talent by duplicating what is in place and would have only nominal authority with the Department of Defense, leaving final decisions on controversial projects to the President. McCormack is a member of House Government Operations Committee, under which has been conducting hearings on the general subject of a federal science program. A companion proposal, introduced by Rep. William French (D-Id.) chairman of the House Government Operations Committee, would set up a \$250 million scientific research reserve fund which would take financial control of scientific projects from budget and accounting agencies. The fund would be administered by the National Science Board of the National Science Foundation to give continuing support to high priority projects and eliminate the present practice of starting and stopping projects with the fluctuations of fiscal year appropriations.

- **Establishment of a Division of Outer Space Development** in the Atomic Energy Commission. This has the strongest backing of the Atomic Energy Commission in the House by Rep. Carl Albert (D-N.C.), the chairman, and in the Senate by Sen. Clinton Anderson (D-N.M.), vice chairman.

Moving rapidly to capture jurisdiction over the emerging field of outer-space, the Commission set up a Subcommittee on Outer Space Propelled by Sen. Anderson, and including Sen. Henry Jackson (D-Wash.), Atomic Energy Committee vice chairman (R-I.), and Rep. Carl Albert (D-Id.).

James Van Zandt (R-Pa.) and James Patterson.

Backed by the McClellan-Humphrey leadership, Humphrey would "grab for authority" of the Atomic Energy Commission. This plan that there is little room room for turning outer-space policy control to the AEC, then McCormack's proposal is to the Department of Agriculture. The McClellan-Humphrey proposal would give the Joint Atomic Energy Commission a House and a Senate Committee on Science and Technology and AEC would become a branch of the new Department.

The proposal of National Aeronautics Committee for Administration to obtain authority over a comprehensive outer-space program (see p. 12) has not yet received official attention in Capitol Hill.

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• **Establishment of a Division of Outer Space Development** in the Atomic

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weapon research present in some existing agencies.

But time, which was the life of the interest, would be lost in setting up a building facilities. Short of an expensive curb effort, up to two years could be lost.

One problem noted is that no future as well as current agency committees and other groups in scientific and technical affairs, and the creation of a new agency would soon be lost to additional confusion and possible risks.

The alternative of placing jurisdiction on an existing civilian agency. There can be several from which to choose but the Atomic Energy Commission appears to be the most logical choice. The AEC nuclear rocket project — Project Rover — provides a basis for further efforts at large-scale nuclear propulsion. There is ample scientific evidence that nuclear propulsion offers the best hope for propulsion of a space vehicle with its potential and long-range and long-term economic potential. But even without this an argument to the Commission is tempting because it is a young agency and has the best laboratory complex in the nation, perhaps the world serves as an advisory reports to AEC on space propulsion.

News Digest

Reaction Mohr Inc. and Thielert Chemical Corp. agreed to a merger last week, continuing the trend toward consolidation of fabric and finishes in the textile propulsion field (AW Jan. 20 p. 34 Jan. 27 p. 31). RMI stockholders will get one share of new Thielert stock for each 14 shares RMI stock they own, each.

Acron-Gescom Corp. expects to add 1,000 professional and skilled workers at its Sacramento, Calif., plants by next June. About one-fourth of the new employees will be in the professional class. Company officials expect about 7,000 people at Sacramento.

Solar Aircraft Co. is a private treaty at strengthening its middle contract with its principal, Nordica-Kitas Corp., insurance firm, and bid by its stockholders. Solar's stock is being pulled up by Bull Manufacturing Co. with view toward possible merger.

Strategic Air Command set a new flying safety record in 1973 with five major and minor accidents per 100,000 hours. Previous low rate was achieved in 1969.

Bergert, Throckmold firm, is ready to fly the second prototype of its B-1000 T-100, light-weight ground attack fighter.



Third Prototype P6M Makes First Flight



Several important modifications are visible in these first pictures of third prototype *Marlin*. See *Marlin* taking off on its initial test flight near Mobile Bay, Ala. (NAV Jan. 27, p. 59). Side view (top left) shows redesigned belly at junction of T-tail having a deeper curve and less than on two previous XP6M's. Also noticeable at a crest rising under the belly to reduce snail-like drag. *Marlin* engines have newly casted four-stage

burner-equipped Allison J71 engine airfoils to eliminate airframe heating problems encountered on XP6M-1. Also shown is redesign of front of engine nacelles to provide more even airflow distribution across engine compressor faces. Navy program for *SeaSkooter* calls for eight XP6M's with J71s, 15 P6M's with P6W J71s. *SeaSkooter* has an intended range of 1,900 mi., speed of over 400 mph with 15-hour payload.



XP6M-1 *SeaSkooter* is escorted by experienced Grumman F4U's. Tips show plane during its recent two-hour test flight. Two

under XP6M-1 is crashed 73 hr. flight time before they were destroyed as a result of malfunctions in the tail section.

Capital Puts 880 Near Breakeven Point

Convair's financial guarantee in turn offers airline an answer to pressing fiscal, equipment problems.

By Glenn Garrison

New York—Capital Airlines has now found a way out of its equipment and fuel troubles, but it may have to wait 15 Convair 580 jets with a fuel and maintenance not necessarily cushioned by the manufacturer.

General Dynamics Corp., whose Convair Division is building the plane, has suggested its converted 580s purchase with the \$60 million risk be approaching the breakeven point.

The manufacturer has agreed to help Capital find money not only to pay for the 580 order but to reimburse the airline's existing \$48.5 million debt for Vickers Viscount equipment. The Convair Division also is aiding Capital by arranging power equipment loans to ride the airline over the interim until the jets are delivered.

Delivery in 1960

Plans call for first deliveries under the 580 order in September 1960, with the rest of the planes arriving over the succeeding year. Nine of the four-engine jets are needed for its present routes, Capital says, with the other six contingent on future expansion. The airline is seeking two new routes in the Great Lakes Service, Case, and the up-and-down routes at least one of the routes appear promising for Capital.

New York Airways Decides on H-14s

New York Airways last week endorsed its previously reported intention to the United AFB by manufacturing a decision to buy five of the twin-engine turboprops.

President John J. Stabile, 58th and 59th, are being sold. President Robert L. Cummings, Jr., said last week negotiations have not yet been made. The United order scheduled for delivery beginning in April is subject to the satisfactory conclusion of discussions now under way with the Civil Aeronautics Board.

New York Airways' commercial Williams West Associates, New York, would like to sell its 14th order. At last Wednesday, an agent said had been made according to industry sources.

World has offered the New York Airways order to helicopter operators all over the world. At the recent American Helicopter Society meeting in Dallas, passed notice of the offering was circulated and a number of operators were approached without any orders being issued.

The helicopter package, which includes tools and training, was also offered to revenue operators including Japanese. Chicago Helicopter Airline was approached, but that operator has just bought two new S-61s. Los Angeles Airways also was approached.

A very good prospect of selling the aircraft to revenue operators along the East Coast could have been good, but an even bigger one of order of new has crashed in a fall in this activity. What left was a look market for helicopter has become very close to a reality.

Order agreement in the case began last week.

When plans in Capital would put total orders for the Convair jet at 65. Laidlaw & Co., the principal financier of General Dynamics, told Aviation Week that breakeven point for the plane "must be worked down that closely," but that the sale "now will pay for itself in the full run."

The two firms' Gross and Case reached an understanding, whereby General Dynamics will lend Capital reasonable assistance with its financing problems. After receiving the airline's problems, General Dynamics said, it decided that with the 580 using Case's 580s, the problem could be "worked out without great difficulty."

Financing Plan

Details of the financial arrangements were not final, Gross said, but it is not contemplated to provide case money out of our coffers.

General Dynamics would go just as in guaranteeing outside firms to Capital.

A spokesman for the airline said, however, that if outside financing could not be arranged, the agreement with General Dynamics to provide money.

Concerning an extension of direct credit to Capital for the 580s, Gross

said such a possibility was remote. He said, General contemplates selling the plane in Capital on the same basis as to an other airline as far as payments are concerned with the normal cycle of down payment, progress payments and final payments.

Producers of the 580s last month Capital to operate competitive operation on 41 air routes states. The airline's president David H. Baker told Aviation Week. The airline's 15 Viscounts can be used more efficiently throughout the routes and Capital can get rid of some of its losses using 12 DC-4s, 14 DC-3s, and 12 Lockheed 040s.

Great Lakes Routes

The new Convair would go on the Buffalo-Muskegon and Detroit-Muskegon routes if Capital gets them in the Great Lakes Case. The Civil Aeronautics Board examines in the case recently reached last summer that Capital be awarded the Buffalo-Muskegon route, then within the recommendation that November. The examiner suggested that if the airline had competitive operation to serve the route, it would accept to be assigned positions and awarded Capital. In the meantime, National Airlines was recommended for Buffalo-Muskegon. Capital also is seeking the Detroit-Muskegon route.

Both routes, Capital considers are absolutely essential to the airline's system to provide a seasonal balance to the system.

Since the 580 order was announced, Capital has withdrawn its request to CAB for a return to schedule. The Board's decision to allow a 4.5% fare increase of course, in another factor in the carrier's high-flying financial outlook.

Apparently as a result of these developments, the airline's stock has climbed significantly. Last week it rose from \$10 to \$16.

Frank Pico, president of General Dynamics, last week said to send a telegram to CAB endorsing the purchase by Capital.

The 580 purchase agreement did not involve General Electric, manufacturer of the GE's TP33 turboprops which will power the plane, according to both General Electric and General Dynamics. Gross and however that GE might possibly come in at some stage in the program.

Arrangements for leasing gates and hangars are being worked out. The General Dynamics official said. The air



Bristol Seeks U. S. Jet Sales

Model of Bristol 200 shows seating of three passengers on tail of the third stage transport. Bristol European Airways has delayed its decision on the aircraft (AW Jan 27 p. 39) pending study of a new financial proposal by de Havilland Aircraft and the outcome of the U. S. sales talks to the combined team of Bristol European Co. and the Bristol-Siddeley Group. Industry sources and a decision favoring the de Havilland 121 was delayed when Bristol-Bristol team reported U. S. interest, particularly in the Air America World Airways. But a British spokesman said, "We look at every airport, are interested in every airport but have no special interest in the Bristol 200."

operation is handling the leasing at a server to Capital only, adding it to the airline package.

Capital would need some long-range equipment to cover a route or routes to Miami.

The leased aircraft could meet its various requirements until delivery of the 580s.

As to possible financing of new transport through credit arrangements between manufacturer and Capital, Gross considers such a head-scratcher.

Capital representatives of the aircraft industry are as great as pointed out that "we couldn't go any far down that road."

'Nothing Unique'

The agreement with Capital concerning the 580 purchase is nothing unique or dramatic. Gross and Baker of Convair 145s to Latin American countries for hotel have been handled in a similar basis in the past, with General Dynamics arranging its financing through commercial banks and their successors, particularly, according to Gross.

Regarding possible agreements with other potential 580 purchasers for the kind of help Capital will get, Gross and Baker it nothing in the world which has reached the same degree of interest "as yet."

Capital's 580s will be in 94-passenger sized configuration, according to the airline.

House Unit Plans CAB Probe

Washington—House Special Subcommittee on Legislative Oversight indicated last week that it will investigate the administration of Civil Aeronautics Board officials.

In another move, the subcommittee headed by Rep. Morgan M. Mueller (D-Mo.) will look into two airline mergers in which the President overruled the Board's recommendations and ruled for an amended order. Cases involved are the North Atlantic Case and the Transocean Case.

Subcommittee hearings opened last week with a general inquiry into the legislative agencies to determine if they are being administered in Congress intended. Other agencies involved by the CAB include the Federal Communications Commission, Federal Trade Commission and the Securities and Exchange Commission. This week, the subcommittee is expected to go into specifics.

Following the first day of general questioning last week, the House is anticipated to find evidence that airline executives have "deliberately" constituted members of the CAB. The report and investigation are examining the kinds of considerations in the Washington area and questioning refused to discuss the interest of interest against or consideration of CAB officials.

The only hint of this beginning of the hearings of possible "wrong doing"

in connection with the CAB was made by Subcommittee Counsel Bernard Schwartz during the questioning of CAB Chairman James D. Burke. Schwartz asked Burke if he felt it improper for any one party to a case to argue its case privately with the executive branch in international air route cases.

Rep. John W. Henson (R-Miss.) objected to the question on the basis that no evidence had been introduced that such a connection had taken place. Schwartz replied that he was prepared to offer background material and that the subcommittee will go into more specific matters at a later date.

Most of the questions asked therefore centered around what effect it has, since 1955 of the Civil Aeronautics Board on the independence of the CAB.

Section 881 states that all decisions pertaining to a U. S. carrier involving its capacity to foreign air services or trans-shipment is subject to approval by the President. It was stipulated in the act in order that the President might consult his advisors over all foreign policy matters, which are of an international nature.

Under Section 801, the CAB may decide a route or route planning for the same interest in domestic route except that it forwards its findings and recommendations to the President for final approval.



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AVIATION PRODUCTS

Domestic Lines Dispute CAB Fare Offer

By L. L. Doty

Washington—Commerce transients last week challenged a Co. 4 fare increase. Board offer to approve a temporary fare boost of 6.6% is "too little and, perhaps, too late."

Although the majority of the nation's 12 domestic trunk carriers last week had indicated their intention of accepting the Board's invitation, the offer at best is an immediate cash-of-hand bill for the airlines. A few airlines took the attitude that "it's better than nothing," but at least two major airlines balked strongly that they were completely dissatisfied with the proposal fare hike.

Earlier last month, for example, had filed for that increase against 12% to 15% as the absolute minimum needed immediately to accept the industry's deteriorating financial condition (AW Jan. 27, p. 38).

Latest action in the long drawn-out fare case shows that a Board in November must that it would permit an across-the-board 4% fare increase on all fares plus an extra 5% charge on all tickets. The revised tariff structure would amount to an average 6.6% fare boost, although the increase would be substantially higher for most mid-air travel, because of the 5% surcharge on the carriers' large volume of tickets sold over short-haul routes.

Industry Measure

The fare increase would be an 18 percent increase, effective until the completion of the General Passenger Fare Investigation. Undoubtedly, the Board will in turn the industry 30-day filing requirement and accept short-term fare requests.

In such an event, the Air Traffic Conference of America, an organization through which all fare increases are filed, is likely to distribute the fare changes through the use of conversion tables rather than 100 hours of Board's general of the fare of all airlines for the various. Should an airline or airline not file for the Board's fare of file for a difficult task, the conference would be required to review all fare increases a procedure requiring time in few weeks.

In announcing the fare, Chairman James Duffie and members Herbert Denny and Lester Ecker voted for the 4% plus 5% increase.

Yet Chairman Charles Gurnea voted for a 10% plus 5% increase, and Members Joseph M. Mott and Robert A. Mott voted no increase at all at that time.

Carriers was the lone dissenter in the

Suspended Passenger Fare Investigation (AW Oct. 7, p. 38) when the Board refused to grant a request to increase fares for a 6% increase. At that time, Gurnea stated that the deal of the "small" fare increase placed the airlines in a "critical financial position."

As late as November, the Board again turned down the 5% proposal by refusing to reconsider its earlier decision against such a move. The Board gave no reason for the sudden reversal of its 1957 stand.

Eastern Airlines was one of the first carriers to indicate its plans to file for the increase. The carrier also filed a plan to expedite a fare decrease in the General Passenger Fare Investigation. Its effort, Eastern's action, was the proposed fare for American Airlines last month (AW Jan. 27, p. 38) except that it would limit the fare for travel to 34 days instead of 60 as suggested by American.

Airlines' Stand

Trans World Airlines explained the malpractice of the adjusted rates in pointing out that the increase would add only \$2.50 to the New York City origin-fare line.

In announcing his intention to file for the rate change, TWA board chairman and acting president, Warren L. Pottel said: "Considering it that time [Suspended Passenger Fare Investigation] amounted to a 4% increase, and the general financial condition of the industry has deteriorated substantially since then. Under Air Line which has been along for a percentage 17% increase, expected disappointment over the Board proposal for its fare, but not decided to ask for the 6.6% increase. American increased fare and there is a strong indication that the carrier would not return to its position for a 15% increase fare hike."

In its filing for the fare increase, Capital Airlines said the Board's offer was "shallow and, perhaps, too late." It pointed out that fare cut losses will not be as great as those anticipated in the petition for action because of an improvement in current operating results. It also to Board Chairman Duffie, Capital's President David H. Baker said:

"What happened on Nov. 6, 1957 (date of the industry filing) to be a serious and immediate financial problem required one approach to the Board. Operating statements filed with the Board recently indicate that with one

exception all domestic carriers presented a loss in the 4th quarter of 1957."

Commenting that the CAB's decision to grant the increase increases Air Transport Association President Stuart G. Tegen's concern the Board of ending its responsibility. In announcing to fulfill them," he said the Board action reflects nothing but a "passive financial search for get acquainted and added."

"It took a Southern to shoot the leg out of our middle program. We've been to and for America the Southern to be available to before the power-up, not appears the need for a patch, however U.S. commercial jet fleet."

Tegen estimated that if the proposed increase for 1958 would be \$1 billion compared to a \$1.4 billion in 1957.

He said that 1958's net profit for the industry would amount to approximately \$25 million compared to \$25 million in 1957.

The malpractice of this annual comes close, he said, when we note that the combined profit for 1957 and 1958 will be about \$25 million, or not much more than the \$27 million registered in the single year of 1956.

The Air Transport Association estimated that the industry's 1957 net profit figure would have been \$50 million instead of \$24 million last year. Board granted a 6% fare increase when it was first requested in March. It accused the CAB of gambling with the future of the airline industry and a "trial" that, because of the current profit picture (AW Dec. 15, p. 20), "there is not enough money left over to adequately help finance the \$2 billion jet expansion program."

Board Vote

The Board acted last week with General again dissenting to suspend the 1957 fare increase filed by Continental Airlines and the petition by TWA for an increase of 10% fare structure (AW Jan. 27, p. 38). Moreover, Capital's strong support to the TWA, plus which vote, for fare cut losses, first class and coach seats.

Capital argued the Board to consider the fare adjustment principle before a fare decrease is reached in the fare case and vital its application of a fare rate to the fare structure is long overdue.

Last fare adjustment is made in 1952 when \$1.00 was added to existing coach and tourist fares. In 1949, a 10% increase was granted but the lower coach rates and some fare discounts were introduced at that time to offset the gain somewhat.



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**Fatigue Signs Ground
21 Viscount 700s**

London—Fatigue cracks in the rear section of the lower spar beam have grounded 21 of the first Viscount 700 flying-ship delivery.

Cracks associated with built holes in the beams at certain undercarriage attachment points were caused by fighting of the skin on the beams in this region during loading.

Only 35 aircraft were passed to the airlines as all subsequent production aircraft incorporated a redesigned deeper beam operating under lower stress levels and fabricated from 2451. This copper bearing material has superior fatigue characteristics to the 7057 alloy previously used. There was also a switch to steel beaded holes along the beam using fitted bolts and the insertion of a laminated plastic "Tornapax" strip between the beam and skin. Bolts were replaced in secondary attachment points.

It was recognized that the fatigue life of the original beam was rather low. But as the strength of fatigue test carried out on a cracked beam, these showed very low propagation rates it was decided that replacement could be carried out as part of a long-term program. This program had been in operation for over a year and 10 aircraft had been modified up to date.

The growing criticism from the Air Registration Board was based on the condition of a beam scheduled to Vickers last week. The cracking was much more pronounced and under test propagated fast enough to reach across the whole beam.

All the replacement beams are ready, having been prepared as part of the original program. Replacement time for each beam is about four weeks.

Withdrawal of the aircraft from service is not expected to have much effect on airline schedules owing to the slack winter season. British European Airways, which grounded 10 aircraft and Aer Lingus two, were both able to maintain schedules. Air France, however, with 10 aircraft grounded, was reduced to half its scheduled route.

SHORTLINES

► Air France is conducting surveys for its new Polar route between Paris and Tokyo with an intermediate stop at Anchorage Alaska. The new route is the result of a recent bilateral agreement between France and Japan as shortening the 3,310 nautical mile service. Lockheed 1049 Constellation are being used for the survey flights and will fly the route when service begins.



Convair 440 Club Compartment Seats 12

Four exterior photos of full-scale mockup of Convair 440 jetliner transport show club compartment (above), passenger folding tables (right) and in-suitcase seating arrangement in four-section first-class configuration (below). Mockup is in San Diego, Calif. Club compartment is decorated with all white shade an overhead sections alternate shades of turquoise, dark blue and white stripes on end portions. Seats have black and white baroque patterned fabric. Compartment seats 12, takes up space equivalent to that occupied by 12 first-class seats. Air lines can change to first-class seating in 4 hr., Convair says. Color schemes have not yet been made in production airlines.





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in April. Air France also has scheduled two special pilgrimages for the next, to Lourdes that start in conjunction with the Catholic Third Office of Working time. The pilgrimages leave New York for Lourdes on April 13 and Sept. 27.

► **Air Transportation Assoc.** reports U.S. scheduled airlines last year operated more aircraft, passenger miles than the railroads for the first time. The association's figures—the first eight months actual, the last four estimated—show that the airlines accumulated over 25 billion passenger-miles the railroads about 22 billion, excluding commuter trains.

► **British European Airways** reports a record net earning of \$1,740,000 for its 1957 calendar year. With their earnings to go until the end of the current fiscal year, Lend Douglas of Kentucky, BSA board chairman, predicts a net profit of nearly \$1 million.

► **Boeing Airways** will begin service from the Southwest to Havana, Panama and other Latin America centers on Feb. 6, with Douglas DC-6 flights from Dallas to Havana, Havana, Panama, Lima, Peru, and Buenos Aires. A second service will depart Dallas on Wednesday for Houston and Rio de Janeiro. The return flights will leave Buenos Aires on Sundays and Rio on Fridays.

► **Frontier Airlines** reports several new gains, mostly for the year ending Dec. 31, 1957. The carrier says it moved 212,900 passengers a total of 37,621,300 passenger miles an increase of 11% over 1956. It transported over 942,600 tons weight of air freight, 30,000 tons more of air express and 214,500 of mail, both air mail and first class mail, during 1957.

► **International Civil Aviation Organization** has selected Taiwan as its 71st member.

► **North Central Airlines** flies 693,930 domestic passengers 102,714,478 air-to-air passenger miles during 1957, a gain over 1956 of 28% and 21% respectively. The carrier flew 164,478 tons miles of air express a 19% increase over 1956, and 191,262 tons miles of air mail, an 18% gain.

► **Seattle-Tacoma International Airport** handled a record 1,435,458 passengers—both inbound and outbound—last year, a 18% increase over the 1956 total. Air mail for 1957 was up 10% to 20,221,316 lb, but slight decreases were registered in air freight, down 5%, air express, down 5%, and first-class mail, down 1%.

AIRLINE OBSERVER

► **Wish for a move:** by Coast Airlines to open a direct commercial air route from England to Mexico. Britain's Board of Trade wants to expand tourist traffic between the two countries as part of a trade package that also involves the purchase of Mexican foreign natural gas, the sale of British oil equipment and aid to Mexico in the development of a merchant marine.

► **Aerovias Meridionales** Board is negotiating with Ansett Australia, Inc. for the development of an electronic air traffic control system to conduct tests on design characteristics for data processing and display systems now being developed by the board.

► **Boeing Airways** will focus out its turboprop overhaul work, but the carrier plans to do its own maintenance on turboprop engines and propellers. High cost of establishing jet overhaul facilities is discouraging trailer truckers from following the practice of overhauling their own engines. Boeing's overhaul facilities will be taken over by Northwest Airlines in Dallas.

► **Soviet Russia** and the U.S. last week agreed "as principle" on direct air service between New York and Moscow (AWT Dec. 9, p. 38). The agreement came as part of an exchange agreement designed to improve mutual understanding between the two countries.

► **Vang Airlines** of Basel will power its three Boeing 707 transports with Rolls-Royce Conway turboprop engines. Engines overhaul will be handled by Rolls-Royce at maintenance facilities now being established in Basel by the manufacturer. Vang chose the Rolls-Royce Avon turboprop engines for its two Caravelle transports on order.

► **De Havilland** has launched a color campaign for its Comet jet transports in Argentina, Australia, New Zealand, South Africa and Lebanon. The company is offering the transport with an early 1959 delivery date.

► **American Airlines** is selling at least 30 Comet 240s to Donald, Inc., a firm specializing in the leasing of aircraft. Ten of the 30 transports were sold last year and another 10 will be delivered in Donald in 1958. The firm has an option on an additional 10.

► **Civil Aeronautics Board's Great Lakes/Southeast** Case opened last week, with 49 applicants and interventions, including 14 airlines, scheduled in testimony.

► **Boeing** placed a sales and engineering team in the U.S. to champion the firm's planned Bristol 200 mph domestic airliner. The group will present to airline management a detailed operating schedule showing performance of the aircraft on a wide variety of U.S. domestic routes.

► **Comair** has so far committed or spent \$30 million on the development of an 880 airport transport, including more than \$10 million in engineering costs. The company also has established an orientation program for airline personnel who do not require detailed technical knowledge but who must understand the broad aspects of the 880 program.

► **United Air Lines** put four million men hours into service overhaul operations last year. The company overhauled 245 airplanes during the year and 1,397 engines, including 11 engines for Japan Air Lines on a contract basis.

► **Nine member airlines** of the newly formed Association of Local and Territorial Carriers met at a recent industry conference with all four members of the Civil Aeronautics Board to discuss local service problems, including an adjustment of the present mail pay system as a means of providing a greater incentive for more efficient operations. Joseph P. Adams, ALTA general officer, acted as spokesman for the group.

► **Six scheduled airlines** serving Denver plan a "hospitality drive" for Air Force Academy cadets. For the second consecutive year, pilots will receive a special program of this airlines will receive cadets from the academy at Colorado Springs to spend Christmas in their homes.



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... A Matchless Tool to Advance the Engine Building Art

Engineers at Pratt & Whitney Aircraft have many matchless tools and facilities to call upon. One of them is the Computation Lab, the largest industrial installation of new electronic data processing equipment in the United States.

In an air-conditioned building at United Aircraft's Research Department, four giant IBM 704 computers, and other data processors, are now in full operation. They compress years of engineering effort into hours. Each 704, for example, is capable of performing about 2 million calculations a minute.

With these advanced calculators, it is possible accurately to predict performance of a complete engine through the whole range of

operating conditions. Theoretical engines, too, can be tested mathematically, to provide knowledge practically unobtainable without computers. For more advanced problems, computers perhaps 100 times faster than the 704 are being developed.

Electronic computers had a major part in the design and development of Pratt & Whitney Aircraft's widely used J-57, and the J-75, most powerful jet engine in volume production. The electronic marvels of the Computation Lab, and many other advanced engineering facilities, will be even more important in future years in the design, development and production of the world's best aircraft power plants . . . in whatever form they take.



PAWNA J-75, shown above, is the first engine to have guaranteed altitude operating performance. It owes much of its design superiority to the work of electronic computers.



Pratt & Whitney Aircraft

Division of United Aircraft Corporation, East Hartford, Connecticut
CONNECTICUT OPERATIONS—East Hartford
Major Branch Plants—Meriden, North Haven, Southington
FLORIDA OPERATIONS—Walt Palm Beach

MISSILE ENGINEERING

Weightlessness Crucial Spaceman Factor

By Russell Hinkle

Holloman AFB, N. M.—Effort in most of prolonged weightlessness is the crucial ground mission in manned space flight programs and definitely at once takes most men until it is better defined, according to Col. John P. Stapp, USAF, Jan. 15, p. 211. Commander of USAF's Aero Medical Field Laboratory here.

The Field Laboratory's research in human factors-outside Col. Stapp's own experiments with acceleration and the human flight under repair include studies by Maj. David G. Simons and Capt. Joseph W. Kottages, Jr.—has done much to build a foundation for selected manned space flights. Col. Stapp credits Navy Capt. Albert A. Bickler with the heavy work on long term survival in a totally hostile environment. Oddly enough, Bickler's study was aimed at solving the problem in manned-powered submarines. The U.S.S. Nautilus, first of the atomic subs, has remained submerged for more than two years and, not far from shore, there is actually no limit to endurance submerged.

Col. Stapp says there is no reason why men can't live as long in space as they can under water, if the absence of gravity can be ignored. Stapp says that just and correct zero gravity enables an astronaut to be free of the difficulties of disorientation between the effects of weightlessness and those of the violent water, motion or air flow of reduced weightlessness is needed to provide an efficient knowledge.

Continued rocket explosions and

the Project Man High Inflates flight of Kottages and Maj. Simons (AVC Aug. 26 p. 51) indicate that ground force mission is actually to give a program to human crews under exposure to over a period of thousands of hours.

Col. Stapp told Aviation Week that reliability standards needed to put space flight on a routine basis must be higher than those for present aircraft because survival is more precious and there is little or no power of escape enabling the crew to abort.

Three Objectives

Stapp and Kottages space flight projects have three objectives. In order of priority, these are:

- **Prove that man can tolerate all conditions of orbital flight including prolonged weightlessness.** It is needed for completion of manned satellite and hypersonic glide vehicles which are already on the drawing boards. These should be tested under weapon systems and communication philosophy.

- **Develop an all-vehicle for all types of interplanetary research.** Military applications of research must eventually mirror the capabilities of the researchers.

- **To prove use of evidence by using weightlessness and weapons as effective as to accommodate the size or altitude.**

Stapp credits Russia's Sputnik flights with accelerating USAF's space research from money shorth, excepting evidence to a revolutionary pace. The trials of the accelerated program have not yet been associated but Stapp

assured Aviation Week that belated gaps of the military potential in space, flight by the public in this country will make good progress possible in the technology of human flight.

Stapp called the launching of Sputnik II an engineering accomplishment of the first order but said that as a biological experiment it could be regarded as only 75% successful since the dog was not recovered. He commented that we must expect certain failures in our first launches with animal subjects because of lack of experience in dealing with the problems of space flight.

He said that no manned space flight should be attempted until we have proved such as able to achieve expected mental enough able consistently.

Crew Utilization

Dr. Simons, in head of the Space Biology Branch of the Field Lab, is especially concerned with the problem of movement the members of the crew of a satellite in space orbit. He told Aviation Week that general measures of aptitude and performance are too crude for the purpose of determining the capabilities of acrobatic and crew utilization in space. He called the development of a more refined one a prerequisite to getting the most out of the crew, as these measures will be found nothing less.

Setting a name for the new measure, Simons decided on "Cerebrality Index." He said it must describe error imagination as well as intuitive under specific circumstances and in quantitative terms. The intelligence

Quicker and speed aptitudes of space crew undoubtedly must be high, but these measures tell nothing about the effect of circumstances on individual performance or the ability to select an opportunity to change a course program or make minor problems on the strength of "in-the-gut" insight. The stress upon the thinker will be high and possibly extreme if the unknown factor of weightlessness turns out to be important. Isolation from the amount of help he can expect from his crew.

The Cerebrality Index would not be an increasing measure of potential performance since its main purpose is to serve as a standard in determining variability in performance due to outside influences. In a qualitative and subjective way, Simons was able to notice changes in his own performance level during his 32 hr shift in Man High II which can be attributed to the unique environment of a telephone booth-sized capsule 100,000 ft up.

Cerebrality Index would provide a means of weighing the results of high altitude chamber tests and other laboratory tests to make them more representative of actual flight conditions. It would also be useful in designing equipment and plotting mission profiles so that the astronaut or soldier will arrive at the critical point of the flight in condition to put out the best possible effort.

Space Flight Study

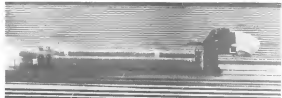
The Man High flights were conducted specifically in space flight study. Kottages went to an altitude of 50,000 ft in the first flight and Simons went to 100,000 ft. At that altitude, only 1/10 of the atmospheric mass remained between Simons and space.

The value of altitude flights is to help to check human reactions to all the known and stresses of space flight with the exception of weightlessness. These include stresses such as fatigue, extreme temperatures and disorientation and others drawing from the subject's knowledge that he is isolated in a completely hostile world and dependent on the instruments around him for his survival.

Most of these are new forms of old problems. Design of the closed control physiology system is based largely on behavior conditions. The impossibility of penetrating outside, as to provide a sensible atmosphere, in the capsule, forced project scientists to devise a way of separating oxygen from state air to create an open circuit system forcing the subjects shared oxygen and exhalation need air in the vehicle. Since less than 1% of the air in the capsule is used by the body and the rest discarded, the volume stored in an open circuit system would have to be 20 times that needed in a closed circuit.



MAN HIGH II inflates in inflated (above) prior to Maj. David G. Simons' 12th flight. Conditions approximated space except for the presence of gravity. Patterns of light and clouds (below) as seen by Simons from 100,000 ft. could have value to meteorologists and geographers.



USAF's Aero Medical Field Laboratory's Bioastronautics Branch is checking effects of acceleration upon humans, as well as effects of weightlessness. Here, a duck was flown over the top of a windblast tunnel being tested at a speed of Mach 1.8. Stagnation temperatures were 850F. The water tunnel on the Pöschel gas pressure used in the testing was cooled and cooled, but before limited intact.



U.S. AIR FORCE PHOTOGRAPH

Thor guidance system keeps its bearings on New Departure Precision Ball Bearings!

The "AChieve"—inertial guidance system proved at recent flight tests of the Air Force's Thor long-range ballistic missile—delivers remarkably accurate performance.

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...is capable of reclaiming oxygen from exhausted air. To avoid a weight penalty, the problem of this order, a so-called non-recharge, was solved with a three-chamber made up of equal parts of oxygen, helium and nitrogen. The carbon dioxide absorbed in the air regeneration circuit is adsorbed by lithium hydroxide. One pound of CO

can be absorbed by 1.51 lb of LiOH. Disadvantages are that it is a highly oxidizing dust that can make one cough uncontrollably for hours if inhaled, and it draws moisture from the air in a reaction which releases heat. Quite a lot of LiOH dust passed the air filter at landing airport of Minn High II. Fortunately, Scobee had the presence



Regulus I Makes 18th Landing

During its 18th landing flight, a Regulus I poses landing controller (top) on its final approach. Officer in bottom photo gave command of landing the ex-control room launch launching pad. The craft was launched from NAB II. Maps and loaded at San Nicolas Island.

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HOUSINGS FOR AIRBORNE ELECTRONICS

of wind to obstruct the and built his bench and he had escaped from the capsule. Water vapor is condensed out of the capsule atmosphere by the desiccant air cooling system during the day and absorbed in a two-stage, closed-loop, cooling system using lithium chloride and magnesium perchlorate during the night when an air cooling system is not needed.

Crew Stresses

Since these systems are essential to life in space, their crew must be set of stresses upon the crew. They must always protect themselves against oxygen leaks, because in many cases there is no reliable alternative. Mr. High II offered a reminder of this. Serious but repeating oxygen leaks began in sets of three, to give the crew ground post-tracking data and in the evening of the second day of flight ground observers began to notice, via JPL crews, Capt. Ernest R. Archibald, physiologist in the Space Biology Branch, visited Sennott to report his observations. This is controlled by the percentage of CO₂ breathed. Mr. Sennott reported a rate of 44 and seemed to signal this as early slightly above the normal 12 to 15. Archibald was alarmed since in a normal session the Sennott showed a lack of weight which might prevent him from using his own life.

The advice from the ground team decided the CO₂ concentration in the capsule and forced it to be 11. Below 10, 1% in the maximum acceptable level. Until the emergency was past Sennott spent alternate 10-min periods

breathing 100% oxygen in the pressure helmet and the CO₂ tanks in all the capsule. Eventually the air oxygen system began to function properly and the emergency procedure could be stopped.

Physicians acting as laboratory subjects have experienced high CO₂ concentrations before without leaving the ability to evaluate symptoms. Sennott has speculated that this must work as first which occurred over a six or eight hour period in the balloons and which might occur in space, perhaps less of an effort to keep pace with the development of the more obvious symptoms. If the point is to be the case, the indications of the crew members will be no one defense against failure of the air oxygen system in space.

Man High III

Man High III, the next balloons flight in the series is scheduled for May or June. Further flights in the series are being considered and a two-man capsule is being designed by Western Research Inc. to increase the number of men and able in a flight.

Mr. Sennott is emphatically against the idea of having a man, perhaps that the crew should be unaffected during the search and the initial part of the flight. He feels there is a risk to be placed in the crew in their operations and worthwhile observations to be made. The high level of oxygen will cause breathing, also, but a slow rate is required in the beginning of the mission. Cal Kopp agrees and that going to sleep and making an

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Students Practice at Missile School

Students at Vane Delmarre Goodell Middle School at Hamden, Mo., practice practice and assembly of Nike-type missiles in laboratory.

ENGINEERING REPORT

A Case History of Environmental Control

PROBLEM

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AND COOLING

GUIDED MISSILE RELIABILITY

PROTECTION OF FUEL CONTROL
EQUIPMENT from destructive vibration and shock in high temperature propulsion section of IRBM missiles.

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MODEL 1332

Robinson Model 1332 is a system-of-gravity
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mounting enclosure allow the flow of cooling air,
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2. Versatile mounting design facilitates adaptation
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Model 1332 protects against the rugged environment in the propulsion section of large
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spring and damping design characteristics. Natural frequency of model shown is 50 cps, for
an increased vibration of 1000 lbs. and
equivalent weight of 5 lbs.

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enter space would make a suitable plot
for a navigator. The difficulty of adapting
to space flight would be com-
pounded by sleeping through the
transition from darkness to unfamiliar
sunlight.

The Rochester Branch of the
local lab is concerned mostly with
the effects of accelerated forces upon
living tissue. It is studying:

- Patterns of deceleration in space and
on re-entry to human tolerance.
- Effects on tissue of changes in total
pressure upon the body, transmitted
through the blood vessels.
- Human tolerance to impact.
- Tolerance to wind blast.

Rocket Sled Track

Operation of the Air Force Missile
Fuel Centers 15,000 lb. rocket sled
test bed next spring will provide the
Rochester Branch with a valuable
test for investigating possible deceleration
patterns. Variables whose behavior
will make it possible to program quite
complicated reactions with some precision.

The Field Lab is expecting to
make about two runs per month. When
space vehicle design studies yield some
deceleration curves, the lab will be able
to simulate them.

This will pose interesting problems
for the sled experts because the sub-
ject will be flying off or on some other
radical direction during the accelera-
tion and it will be necessary to prevent
the effects of this from making the
data taken during the deceleration part
of the run.

The total program experiments laid
beyond the present space flights is a
set of problems that are expected to be
solved.

Pressure Fluctuations

Those deal with pressure fluctuations
in the causal atmosphere which
can be caused by valve action in closing
as the air molecules are or by leakage.
Wind blast during escape within the
atmosphere also can be dangerous, by in-
creasing the total amount of pressure
on both surfaces.

Field Laboratory searches on cir-
cuits, the critical phenomena referred to
Col. Stapp in his second speed run
on the rocket sled and George South
of North American Industries in his super-
sonic option.

The experiments will be carried out
in special pressure cell and the interior of
the subject's eye will be photographed
to measure deflection or failure of the
retinal blood vessels. A large piston
pump will vary chamber pressure by as
much as 50 atmospheres at a rate of 10
psi.

The working will probably last for
only one to three seconds at first until
some data has been collected on effects.

Scientists Simulate
Re-Entry Conditions

Philadelphia—Using gas subchamber
experiments at General Electric Co.'s
Mach and Outflow Section Depart-
ment has succeeded in simulating the
environment that will be encountered
by an ICBM nose cone on its brief but
critical months into the atmosphere.

The new area is similar in operation
to General Electric's signal water-
tunnel in (AIAA May 11, p. 34) but one
gas instead of water in the nozzle and
high-speed, high temperature plasma

jet. Air gas can be used as the new
area, but General Electric intends to
first have concentrated on dry air to
learn things and upon
Designed specifically for use in Gen-
eral Electric's nose cone research, the
area simulates various parameters of heat
transfer, temperature, pressure and ex-
tremes of chemical reactions which cause
spatial severity, such as:

The signal water-tunnel area, ex-
plain the conditions that occur on the
density of the re-entry environment
limited as it was to its original molecular
composition of hydrogen and oxygen.
It got around the last time Gen

Buckeye's

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cost, basic refueling operation. Also
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non-drip valve in end of tube.

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drop of 1 PSI through inlet and outlet.
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valves, No. 4002 series hydraulic operating
valves.

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No. 4002
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No. 10000
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and Electronic systems used in the air and water. These are, in addition to the original water-based systems, are used for high temperature material testing, the following: A research are used to study the effect of a magnetic field on behavior and properties of a plasma jet. A reference are which is a very pure air and serves as a standard, an anemometer are which simulates pressure distribution. A spectrometer are, used to study properties of materials and gases, and a spectrometer are which are simulate the characteristics of oxygen molecules.

For the future, General Electric is active in working on the development of larger and more refined air, free from contamination and with improved flow, stability and temperature control characteristics. This, there is no way at present to permit measure temperature, pressure and material composition at the extreme conditions encountered in a motor, and this is another position the scientists were hope to solve.

University Planning Materials Lectures

Penn State University is offering two short courses designed for engineers. Closely allied with today's emphasis on research and development, the courses are intended for design engineers and others engaged in research on materials. Lectures will be given by a number of prominent scientists and engineers.

First course, on Materials Engineering Design for High Temperature, will be held June 25 to July 5 at the Penn State campus.

Course will include metallurgical properties, mechanical static properties at high temperatures, thermal shock and fatigue properties and design for high temperatures.

Course on Mechanical Properties of Materials will be conducted July 7 to 11, also at Penn State.

This course will cover hardness of metals, plastic behavior of metals under static and combined stress, creep resistance and high temperature properties of metals, fatigue strength of metals, effects of radiation, dehydrogenation, corrosion, and mechanical properties of materials under high speed loading.

Further information on either course may be obtained from Joseph Martin, Department of Engineering Mechanics, Pennsylvania State University, University Park, Pa.

Wind Tunnel Creates High Speeds, Heat

A wind tunnel designed to develop speeds of 15,000 mph and temperatures of 10,000°F is now under construction at Lockheed's Skunk Works Division, Palo Alto, Calif.

Known as a "hotshot" tunnel because of the extreme speeds and temperatures, it will be used to test new missiles for the Navy's fleet before missile Project. It is expected to be ready for testing in early spring, making it the third tunnel of this type in the free world.

USAF Research and Development Command has two similar tunnels at its Langley center at Tidewater, Va.

The tunnel is 44 ft long, 6 ft high and has a diameter of two feet.

Power for the air blast is generated by a 30 million kw electric motor which supplies compressed air to an inlet air compressor at one end of the tunnel.

The superheated air expands through a diaphragm and enters down a 10-in. vertical chamber, the hot gas enters creating heat and heat conduction similar to those encountered in the hypersonic flight region.

The expanded gas expands into a throat of a 10-in. diameter at the end of the throat.

Using time is limited to one breath (1/10 sec) in present the tunnel from entering under the 10,000°F temperature.

The electric air, generated by 170 condenser units, creates power of 10,000 hp to provide the motive force of accelerated air.

The model will be experimental and high-speed electronic camera will be used to photograph wind tunnel experiments.

Marquardt Revamps Air-Space Group

Marquardt Aircraft Co., Van Nuys, Calif., has named the company's air and space flight section "AIRCRAFT" as the Air Force Travel Research Organization. John A. Dierke will be director of the former long range planning and research division.

Research programs in the propulsion and aerodynamics field covering various ranging from low level atmospheric performance through space operations are being conducted. Future emphasis will be given to developing systems elements of various power systems to develop new concepts of propulsion from the surface of the Earth to outer space. Fred Doug Ray, Jr., Marquardt will



A Binks Model 7 spray gun is used to spray the process control in ship control for the plane Bunkers' control. Location: Bunkers' Aircraft Corporation's Wichita, Kansas, plant.

Binks spray guns provide "wings" for finishing schedules

Fast application of mirror-smooth, tough-yet-flexible finishes to wing sections is a job tailor-made for Binks spray guns. Their excellent balance, ease of use, and rugged construction, and almost effortless triggering action reduce operator fatigue and boost painting production. Fully adjustable needle valve compensates for wear, a common cause of faulty spray patterns, spalled finishes and work stoppages.

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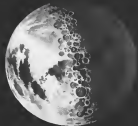
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Flight Control—Honeywell built on experience in development and producing the control systems for 1-100 Mach speeds and missile.



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Warning and Warning—Honeywell advances in advanced warning systems and primary warning systems, all-weather, systems of high altitude, systems in all-weather systems.



Navigation—Honeywell designs and builds systems for navigation systems for all speeds, high altitude, systems and altitude systems. There is no place where Honeywell can't go.

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Honeywell

H Military Products Group



PIRMAFITTING, doughnut-shaped plasma tube used for controlled thermonuclear power research at Los Alamos Atomic Laboratory, has produced up to millions neutrons per discharge for research at about two microseconds. Neutrons are an indication of thermonuclear fusion but can also be produced by other

means and it is difficult to distinguish these sources, Atomic Energy Commission has cautioned. Tests indicate an effective plasma temperature of about an million degrees Celsius. This is still less encouraging fraction of the 100 to 400 million degrees required to be necessary for thermonuclear power generation.



GLASS doughnut-shaped tube filled with deuterium ions tested at Princeton. Capillary enclosure for tube is employed to develop use of around magnetic fields used to contain hot plasma and prevent it from cooling in contact with container walls with consequent loss of plasma temperature, loss of active neutrons, and erosion of "tube neutron."



SPLIT-SECOND switching of hundreds of thousands of neutrons control of thousands of volts is one of the biggest problems in producing controlled fusion power, Atomic Energy Commission says. Techniques now used employ split gaps whose facing leads can be accurately controlled. Controlled split research soon is shown there.

U. S., British Scientists Stress Research in Thermonuclear Power Tests



COLLUSION II, one of Los Alamos machines, which runs a doughnut tube, has repeatedly achieved there to five million degree temperatures of about two microseconds. Neutrons are an indication of thermonuclear fusion but can also be produced by other

means and it is difficult to distinguish these sources, Atomic Energy Commission has cautioned. Tests indicate an effective plasma temperature of about an million degrees Celsius. This is still less encouraging fraction of the 100 to 400 million degrees required to be necessary for thermonuclear power generation.



COLLUSION II-4 plasma tube (center) is larger than one used in Collusion II, has produced lower temperatures (1 million deg.) and lower neutrons (40,000), but has shown that field produced by plasma current is highly reproducible. Particle energies of 300 electron-volts have been achieved with voltage under 20 kv.



NEW MACHINE of industrial type now under construction at Los Alamos. AEC says it is spending 30 times more for thermonuclear power research than was that in 1953 at Los Alamos, University of California Radiation Laboratory, Princeton's Plasma Research Center, MIT's Oak Ridge National Laboratory and New York University's Institute of Mathematical Sciences. Major General Bernard L. Schriever recently and thermonuclear sector is further over this effort, but doesn't getting the program (AW for 27 p. 35). Comparable British efforts are shown on p. 64.



GRAND ZETA (Zero Energy) Thermomelter Assembly, at General Atomics Energy Research Establishment, has achieved temperatures of 2 to 5 million degrees and kept heat plasma under close control. Tests are significant that plasma confinement system can be increased. Questions of whether reactions are produced in thermomelter reactions has not yet been definitely established but reactions between plasma control and neutron production suggest fusion.



KING SHAFID plasma chamber for ZETA is about 18 ft. dia., more 3 ft. diameter tube—its largest than C-5 machines. Tube consists of 260 coil rings, now produced up to 1 million sections.



WORKING model shows primary winding of transformer (below) which induces high-current pulse in qualified glass tube where plasma forms short-circuited secondary winding.



RELIABILITY POSES FOR ITS PICTURE

At Raytheon, hundreds of subminiature tubes are checked each day by an auto static X-ray process. Microscopic welds and spacing of elements are scrutinized to help assure reliable operation even under the most critical conditions.

Electronic
Electronics



This is only one example of the rigorous inspection and testing techniques that have earned for Raytheon components and systems a reputation for the utmost in reliability.

RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASS.



Tactair 9901 Selector Valve, a 4-way solenoid-operated, pressure-sensitive valve for a rocket release system. In addition, these components meet the rugged and light weight and provide instant dependability.

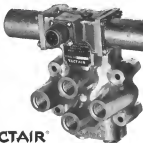
Memo: to missile men looking for dependable components

Solenoid operation, high flow capacity and low leakage are important requirements for gas turbine and hydraulic valves used in rocket and missile control systems. In addition, these components must be rugged and light weight and provide instant dependability.

Case in point: this 4-way, solenoid-operated, pressure-sensitive valve for a rocket release mechanism. To meet its rapid, dependable operation, over a wide range of operating pressures, we combined a number of tried and proven design principles and intelligently in other models. And to maintain weight, we made the valve a pilot-operated unit.

Result: an exceptionally wide pressure range of 500 to 3,000 psi at a shutoff from one level to 70,000 lbs. ft./sq. in.; high flow capacity for a valve this size—actual flow factor of 3 lps. Low leakage—less than one drop of air per year. Rugged operation—On one year warranty. And with that is a weight of only 1.9 lbs.

Reminder: an installed or special component, we welcome the opportunity to assist you with your most precise valve problem. Every job we do is done on a government type. In fact, many of our 18 years' Tactair Valve Division, Aircraft Products Company, Indianapolis, Pa. 46206-1500.



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ENGINEER, cross section fuel pump motor into Westinghouse test tank.

Fuel Pump Motors Submerged for Test

At its aircraft equipment department in Lima, Ohio, Westinghouse Electric Corp. has set up a test facility to evaluate the performance of aircraft fuel pump motors while submerged in high water head.

Heart of the facility is the two-chamber test tank. During a test, the fuel pump motor is suspended in the top chamber which is then flooded with 165 gal. of high octane fuel. The bottom chamber contains dry air. An access hatch in the lower chamber enables an operator to make the necessary power and thermocouple connections to the test of the pump motor.

Cable in the top chamber can heat or cool the fuel in required, and both chambers can be evacuated to pressures corresponding to an altitude of 65,000 ft.

The high octane fuel in the upper chamber is circulated by a pump at rates up to 200 gpm., while valves in the piping control the flow on the test motor.

Canadair CL-44 Uses Turbine Power Unit

Auxiliary power unit for the Canadair CL-44 transport will be supplied by the Engine Division of Blackburn and General Aircraft Ltd., of England, the British firm and recently.

Order is for Airborne 518 gas turbine engines which provide shaft horsepower in addition to compressed air bleed, the fuselage driving an alternator and the latter being employed for starting the main engines and air conditioning.

Unit can be certified as a self-

contained power pod 74 in. long by 24 in. in dia.

Turbine has a single-stage, single-rotor centrifugal compressor and a variable combustion chamber. There is a two-stage axial flow turbine, and the direct drive is taken off via helical spur reduction gears. Unit develops 50 shp while operating compressed air at the rate of 115 lb. per min. at a pressure ratio of 3.7.

Boeing's 707-720 Is for Medium Hauls

Seattle—Working from the best 707 120 jet Stratoliner, Boeing Aircraft Co. has modified structure according to a lower gross weight and shorter range operating envelope and combined the modifications with improved performance (12,000 lb. dry static thrust) and lighter weight of JT3C-7 Pratt & Whitney Aircraft turbojets to produce its 720 medium range jet transport.

Airplane has standard dimensions as basic 707-420 with shorter fuselage (129 ft. 10 in.) of the two offered in the 707-120 series. Wing area, 2,413 sq. ft., is the same for both planes.

Wing and fuselage structural weight has been shaved with the reduction in fuel weight, so that highest maximum gross takeoff weight with the 720 is



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East Germans Build Soviet Il-14s

Two Dornier Il-14C piston transports being built under Soviet license in East Germany are shown at Brandenburg, Dresden-Klotzsche, factory. Block design covers area of two and 18 passengers. Transport is produced for being obtained by long, lightweight aircraft.

from an engine in short in 150 hp. Boeing figures place the 730 horsepower load at approximately 51 passengers, no cargo aboard on a 590-nautical-mile stage with a five-day speed-boosted engine, at the normal gross weight of 155,000 lb. Air Yards' test data formula on direct and indirect costs was used, giving a 9.75 cents per-gallon per passenger-mile rule. Fuel metric for 15 lb. holding was allowed.

Navy Signs Contract For KDA-4 Firebees

Navy has awarded Ryan Aeronautical Co. an \$5 million contract for production of 400 right-attack model KDA-4 Firebee drone. The company and contract includes 51.75 million worth of spares and extends Firebee production into the latter part of 1959. The new order will be placed in with

present production of KDA-1 Navy and Q-1A Air Force versions in final assembly at Ryan's new Tempe, Calif., plant. Plans are indicated at the main plant in San Diego. Design scales up to 95,000 lb., eight engines in rear in line.

Piasecki, Breguet Sign Exchange Agreement

Piasecki Aircraft Corp. and Ateliers d'Aviation Louis-Breguet of Paris, France, will exchange technical information under an agreement signed by Frank Piasecki, president of the American firm, and Jean Ziegler, director general of the French company.

The agreement which tentatively sets for a 10-year duration, includes sharing specific research design, production techniques, and research, engineering and testing facilities. Contract also covers cross licensing of patents, materials

testing equipment, and reciprocal sales rights in the U.S. and Europe. Piasecki is reported to be interested in some Breguet S 101/VTCH, designs. A version of the Breguet 940 STCH, transport (AVL Jan. 17, p. 78) is known to be entering flight test stage in France.

Agreement between the two companies is effective immediately and Breguet engineers are now in the U.S. for technical conferences.

Lockheed, Machinists Sparring on Contract

Boeing-Lockheed Aircraft Corp. and Lockheed Division and Lodge 727 in the International Union of Machinists, are in negotiation for a new contract to replace present one which expires March 5. Some 45,000 employees are represented by the bargaining units.

Lockheed management, in a statement issued by Bert Munnich, Lockheed vice president and general manager of California Division, says current contract demands would total 80 cents per hour increase in wage rates, fringe benefits, "besides other cost items including additional items which we cannot now even begin to estimate accurately."

Magnitude of union demands is indicated by the fact that if they were granted in toto, they would increase

Columbia Division's payroll and fringe benefit costs by \$10 million a year—31%.

Machinists Lodge President John Sieder, who heads union's bargaining committee, says union is asking a 33 cents an hour pay increase to match cost of living increases granted in other plants having similar status, which Lockheed contract does not have, plus a 5% blanket raise. Union wants demands. Sieder says, will cost 27 to 28 cents an hour.

Union also is asking a 54-hour week, for 48 hr. per, which has been asked in several years, also asks union shop security, base for health, welfare. Sieder says personnel union personnel have no protection in contract for its efficiency, that if company, discharge a man for inefficiency, it will stick. Flow rate union says it also wants some protection for senior rank among senior wages in case of later reduction.

North Americans to Sell Australians F-86 Parts

North American Aviation Los Angeles Division will supply Commonwealth Aircraft Corp. of Australia with 5990, 100 parts of F-86 parts.

Commonwealth Aircraft has a contract to build Avon turbojet powered Sabres for the Australian Department of Defense.



Helicopter Offloads Lightplane

Recently 1908-1 ground purpose helicopter lifts Cessna OE-1 observation aircraft from the right side of the U.S. Lake Champlain and carries to camp in Idaho. Operators use part of Marine Corps helicopter training contract.

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(Send for Data Sheet 128 and 141)



8750 Series
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Micro switch "ss" Series of subminiature switches combine small size with completely sealed construction and precise operation. They are the smallest and lightest of environment-free switches. They will give trouble-free operation in temperature ranges from -80°F to 130°F .

The switching unit is sealed with an elastomer plunger seal which is bonded to the pin plunger and the metal housing. The switch is embedded in an epoxy casting resin within the housing. Ejectors of the housing is corrosion-resistant treated aluminum.

Basic "ss" switches are for in-line plunger operation. They may be used with auxiliary actuators for cam or slide operation.

(Send for Catalog 77)

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Micro switch Series "ss" switches are completely sealed against the effects of changes in atmospheric or environmental conditions. The precision switching units are housed in an airtight enclosure. The enclosure is evacuated and filled with an inert gas under pressure, ensuring constant operating characteristics of the switching elements.

The actuator mechanism operates through a seal which prevents entry of dust, moisture or air into the switching chamber and assures maintained pressure of the inert gas. An air scraper ring on the actuator shaft removes any air or dust which might collect on the actuator, thus preventing plunger jamming or binding. These switches are available in a wide range of actuation, and mechanical and electrical characteristics.

(Send for Catalog 77)

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The "pull to unlock" 1540 Series Toggle Switch has a positive lock which holds the toggle lever in a "set" position. A definite pull (approx. 10 lbs) must be made to change the lever position from one locked position to another. This insures against accidental movement of the toggle lever.

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- Positive lock lever guard
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(Send for Data Sheet 124)

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AVIONICS

IGY Data Adds to Earth, Space Theories

By JAMES A. FARR

Washington-New understanding of Earth and the open around it is coming from data gathered during the first five months of the International Geophysical Year. Especially, the studies of the upper atmosphere, thus, addition to man's knowledge of his environment suggest potential improvements in the astronomical and meteorological. Then in detail:

• **High altitude flight.** Earth's atmosphere apparently extends much higher than previously thought, implying an unexpected heating problem for missiles, satellites and man-made orbital space vehicles. Reentry problems are caused by these objects potentially alter new methods of detection and communication.

• **Radio communication.** Increased knowledge about changes in the ionosphere can improve the reliability of radio communication by using prediction of propagation conditions and radio blackout.

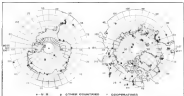
• **Wireless.** Studies of whistlers—very low frequency radio waves generated by lightning strikes—show that they are reflected back and forth over paths extending several thousands of miles into space between physically related (propagate) areas in north and south hemispheres apparently following lines of the Earth's magnetic field. This work of propagation may find uses in point-to-point communication.

• **New power sources.** Three great lines the currents with strengths that run much several hundred thousand amperes, circle the Earth. Two of them circulate under the north and south magnetic poles while the third follows the Earth's geomagnetic equator at altitudes as low as 100 mi., offering a large potential source of power.

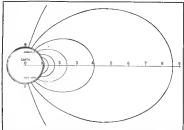
Report on participation of the U.S. National Committee for the International Geophysical Year has been made by Hugh Odell, its executive director, published in a recent issue of *Science*, a publication of the American Association for the Advancement of Science.

Major Findings

No find them in world capable of fully explaining the phenomena between Earth's upper atmosphere and the Sun comes under test but the upper layer of the atmosphere is becoming increasingly apparent as more of the system are found.



Two of the three most of electric current flowing around the Earth through the ionosphere inside the north and south magnetic poles in the area of maximum current frequency shown in applied loads. Ideal electric current under the equator IGY geomagnetic stations of U.S. and other participating countries are shown, as well as cooperative stations.



WHISTLERS are believed to provide the ionosphere and follow the Earth's magnetic field into the opposite hemisphere. Sketch shows Earth's dipole (idealized) magnetic field for each 10 deg. of geomagnetic latitude. Shaded area is the known ionosphere. Scale units are equivalent to Earth radii; dashed line is the whistler path from Acapulco, Mex. to Cape Horn.

Thames that apparently are being confined in the IGY data is a worldwide picture of the Earth's atmosphere in its various aspects, as described, said it merges with a known interplanetary atmosphere that is part of the Sun's corona. At the distance of Earth's orbit from the Sun, the density of this solar

atmosphere is about 1,000 particles per cc. mostly protons and electrons (AW Sept. 3, p. 111).

Earth's atmosphere has been exposed in rapid reflection back waves through the P region of the ionosphere (about 200 mi.), but very little is known about the regions above

height. Measurement of the data at which Spectra 1 and II were shown to be frozen, however, indicate a higher atmospheric density than was expected at these heights.

Ionization Density

At altitudes between approximately 60 and 100 mi., X-ray and ultraviolet radiation from the Sun causes direct, ionizing and negative-particle layers of the atmosphere. Ionization density increases during sunlight and decreases at night.

Because as the Earth rotates the number of ionizing particles varies at any one point and because of the influence of the Earth's magnetic field, large electric currents are generated in the ionized region that flow at right angles to the Earth's magnetic lines of force.

One such current circles the Earth at the geomagnetic equator while two others circle the north and south magnetic poles. Magnetic effects observed during aurora indicate ionization values may originate in these areas of electric current.

The ionized electric current, in order to balance the peak solar currents at the local noon, is believed to return down in electron shells (the so-called "electrojet"). This highly intense belt of electric current is believed to be only about 120 mi. wide.

Not only does the electrical density of the atmosphere vary diurnally, increasing in sunlight and decreasing at night, but experiments conducted near the geographical poles where the day or night is an months long show distinct variations that are believed to be associated with geomagnetic activity. Studies of these results may change our concepts of the ionizing and accumulation process in the atmosphere.

Solar Activity

Because the ICY has been scheduled for a period of maximum solar activity, many of the effects of solar activity as well as upper atmosphere and magnetic field can be studied in greater detail than has been possible in the past.

Particles radiated by the Sun reach the Earth at all times, but during the eruption of solar flares along the rim of visible magnetic storms in the Sun's surface the bombardment of the upper atmosphere increases markedly with a wide range of effects.

One effect is the fading or "black out" of radio signals. Apparently it is the result of particles reaching the ionosphere in the D, or lowest, layer of the ionosphere. The increased electron density causes much greater absorption of the electromagnetic energy which is dissipated rapidly through collisions.

During these periods a new layer of

ionization is created about 12 mi. below the lower limit of the D layer. It is related to the increased X-ray emission from the Sun during flares.

Particles emitted in solar three-solar flare eruptions are responsible for unusual magnetic storms. Simultaneous radio observations indicate that currents exist in both the northern and southern hemispheres simultaneously, something long suspected by scientists but not positively established.

Auroral displays appear to result from the deflection of solar particles to the magnetic poles. As the particles enter the atmosphere, a complex series of collisions produces ultraviolet radiation. This radiation excites different components of the atmosphere as a function of frequency, causing them to emit their characteristic light.

Two theories exist as to how these ionized particles are ejected during solar magnetic storms. One states that these ions are ejected in various directions away from the Sun's surface, so that these streams are formed through space as the Sun rotates on its axis. The other suggests that ions are ejected in clouds or bursts by the storms at varying intervals. Both of the impact of these particles on the Earth's magnetic field cause magnetic disturbances here in either case.

Radio Waves Amplified

An interesting effect of fast particles striking the upper atmosphere is that they are believed to transfer energy to very low frequency radio waves forced there and amplify them in the same manner as in a traveling-wave tube. Although at these particles (about 1,000 e.v./mi.) is only slightly faster than the group velocity of these radio waves, therefore the particles could be imagined as pushing the radio waves along with them. This hypothesis would account for a previously unexplained type of very low frequency radio noise.

Magnetic field of the Earth extends into space indefinitely. A node of propagation which a radio wave appears to follow, these lines of force form into a magnetic loop in a magnetic axis in the opposite hemisphere has been identified each month.

Very low frequency radio waves generated by lightning strikes that exhibit this mode are called whistlers because of the descending whistling they produce in a radio receiver. Although the propagation paths extend thousands of miles into space, whether signals have been recorded that were reflected back and forth over 21 times, traveling a total distance of more than 668,000 mi., with little loss of power.

One of the most interesting aspects of whistler propagation is that the signals are believed to travel outward to

maximum distances with little loss of energy and to be amplified during return by the ionizing wave effect described above. Estimates of electron density along the path (130-150 electrons per cc) appear to substantiate the theory, based on group velocity.

Cosmic Rays

The upper atmosphere is bombarded by two different types of particles: low energy ions radiated by the Sun that take from 24-48 hr. to reach Earth and relatively high energy particles coming from depths of atomic nuclei that reach the atmosphere with energies between 10^7 and 10^{10} electron volts.

These high energy particles are called cosmic rays. Their existence has been known for 50 years but their origin and nature remains to be found. They seem to be all directions, although at times in bursts the Sun radiates cosmic rays of lower atomic energy.

Low energy cosmic rays are deflected towards the two geomagnetic poles by the Earth's magnetic field and only the higher energy particles penetrate to the surface at the middle latitudes. The line where the cosmic ray intensity is maximum is called the "cosmic ray equator."

The cosmic ray equator has been found to deviate substantially from the geomagnetic equator. Measurements have shown that this deviation is between 30-40 deg. upward in the north of the geomagnetic equator. This varying is believed to indicate that the rotation of the Earth's magnetic field as it turns on its axis in space, which is a stationary conducting medium, acts up into the magnetic field that after the structures of the remaining cosmic ray particles.

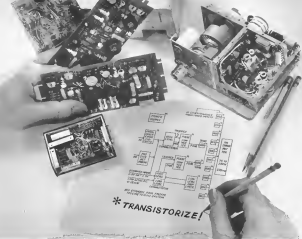
Bright Radar Display Is Visible in Daylight

Carl Koenigsmann, Administrator and U.S. Navy has placed orders for a French-developed bright display radar system which he will use as an aid in navigation to follow their lines of force from the ionosphere to a magnetic axis in the opposite hemisphere has been identified each month.

System consists of conventional radar information into a television signal for display as a simulated television screen. Radar video mapping also can be displayed at will with the addition of a hole vision camera mounted on the controller's neck. Aircraft identification and ground target can be superimposed on the video picture (NAV March 25 p. 54). Contract was awarded to Hughes Aircraft Company's Electronics Group, Torrance, N.Y. The company is 50% French owned and 50% U.S. with most of the U.S. share belonging to American Instruments Laboratory.

Contract awarded by the CAA after

CONTRACT W876, February 3, 1958



NOW... get more data on Strays and Long Shots with TI transistorized PDM/FM/FM telemetering systems

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*TI Pulse Duration Modulation telemetering equipment shown, clockwise from lower left: Sub Carrier Oscillator; Phase Discriminator; Low-Level Amplifier; Keyer; Single-Package 200 W Transmitter.

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30 watts/cw channel for 13 73-440 new converter units for a total price of \$113,900. The 73-440 equipment is composed of the radio-to-television signal converter unit, does not include either TV monitor or TV camera for data representation.

CNA plans to install the units at Los Rios Traffic Control center and airport traffic control tower where long range sets are in use. Under present plans, all but two of the installations will utilize the video mapping unit of the radio, displaying combined data on 70 in. fluorescent monitors.

Other two installations will be for tracking the technique of reporting on the video display, a picture of the controller's work table which shows layout of airport and aircraft identification markers.

Key contract is for the installation of two complete units, including new converter, monitor and camera, to the Radar Air Traffic Control Center (RAI/CC) of the Oxnard, Va., Naval Air Station, where this will undergo operational evaluation. Award for \$116,900 includes preparation of technical manuals.

The complete contract has the name SPANRAD, a contraction of Supergraph Panasonic Radar Display. Advantages claimed for SPANRAD are:

- Target retention: Controllable video

transmission rate allows controller to scan the post track of an aircraft and predict its future position.

- Bright display: Display is visible under conditions of high ambient light.
- Adaptability: Wide variety of video display integration studies. TV camera work is adaptable for use with the same conversion equipment.

- High resolution: Television display provides higher resolution by channel mapping, allowing all target entries and entry rates.
- Close calling: Transmitted video picture can be transmitted from one controller to another by conventional means or links or console cable.

TYPE FILTER CENTER

• Tall Tom Makes TEAM—Electronic countermeasures reconnaissance is done, called Tall Tom (AN/ALD-3) to detect second and analyze enemy electronic magnetic emissions over wide range of frequencies, will be developed for Air Force by Hughes Electronics Corp. and associated firms under what Sperry calls the TEAM (Total Engineer and Administrator Management) approach. The SRI analysis development will be directed by management and technical coordinating groups con-

sisting of representatives of the eight companies involved. (Start details on the Hoffman approach were reported in May 6, 1957, issue of *Avionics Week*). Associate sub-contractor includes Control Associates Laboratories, Edison Co., Lockheed, Air Craft Services, Chance Radio and Television, Radiation Inc., Sanders Associates and Stanford Research Institute.

• Three-D Air Algebras—Aerospace Modelers: Board plans to obtain a three-dimensional radar from one of the military services to evaluate its usefulness in the terminal area for obtaining battle-related information on aircraft altitude, as well as bearing and range.

• ECM for B-52-Spern: Gooseloe has confirmed earlier Avionics Week report that it has been selected to design and produce an electronic countermeasures pod for B-52 (AW June 24, p. 18). Solution will provide "evade-homies" from all electronic countermeasures" including both active and passive techniques. Spern says Approximately 45% of program will be subcontracted to outside firms.

• Coast Gas-Twirling new tube research produced by Radio Corporation of America is for the heli-synch tube produced by company since it began 25 years ago.

• Miniatured Tower—The post Navy DPM program to develop miniatured, high resolution, airborne Tower set is pointed to weigh about 60 lb., will be as mounted shortly. Contract was awarded to two contractors for parallel programs. New Falls will be identified as AN/ARN-52.

• Long-lived Transition—General Electric reports that some of its transition tube now operated for more than 25,000 hr with no change of characteristics, the equivalent of eight hours' operation per day for nine years.

• Signed or Dotted Line—Major contract awards recently announced by a number manufacturers include:

• Collins Radio has received \$774,000 order from Texas World Airlines for new, lightweight communications radio given component for 174s 13 Boeing 707 aircraft. Included are automatic direction finders selective calling VHF VOR glide slope and marker beacon receiver and VOR transmitter.

• Lohmeyer reports a \$17 million contract from Navy for digital computers to be used in shipboard (see story).

• Servomotronics, Inc., has orders of a \$1 million Air Force contract for Type MG-7 computerized instrument control and data computers.

Expansions, Changes In Avionics Industry

General Electronics Defense Electronics Division has established new Defense Planning and Development Operations (DLDPDO), integrating five defense components: Defense Evaluation Operations, Washington D. C. Technical Station Planning Operations, Santa Barbara, Calif. Electronics Laboratory, Syracuse, N. Y., and Flight Test Operations, Johnstown, N. Y. Raymond S. Henschel (May Co. USAF) has been appointed manager of combined operation.

Other recently announced reorganizations and changes in the avionics field include:

• Minneapolis-Honeywell has established new Avionics Equipment Division to be headquartered at Pittsburgh, Pa. which will produce airborne control systems for ground facilities of "terminal protection" U. S. missile programs. New division located in Marshall Field is expected to employ 178 persons by end of 1958.

• Hoeser Electronics Co. has moved into new half-million dollar 51,000 sq ft plant and office facility at Tacoma, Wash.

• Infrared Standards Laboratories, Riverside, Calif., a new subsidiary of IR Industries, Inc., which will provide facilities to government and industry for test and evaluation of infrared devices and for design and production of IR instrumentation. New subsidiary, located by Arthur I. Cooney, former chief of Naval Ordnance Laboratory Infrared Division is located at 10155 Magnolia Ave.

• Atlantic Research Corp., Alexandria, Va., will build, ground to March for new \$1,000 sq ft, million-dollar facility, expected to be completed by year end.

• U. S. Industries, Inc., has opened new 70,000 sq ft assembly and development center in Pompano Beach, Fla.

• Aerospace Associates Corp., Hyde Park, N. Y., has added one-story building to present location. Company's EPR is processes in 10 units.

• Armstrong, Inc., Florence, Ala., has added two double glass and personnel serving total facility to 9,400 sq ft.

• Hallock Co., Chicago has been granted by Bendix the Hallock family from Penn-Tec Corp. which purchased company south two years ago.

• Bradco Avionics Corp. Computer Division has opened new and expanded office in Washington, D. C., at 1009 Canal Ave. NW.



The Care and Feeding of MISSILES



Male Fueling Nozzle and Adapter

A lightweight Liquid Oxygen pressure nozzle and adapter, forecasting high flow rates (over 1,000 gpm) and minimum pressure drop designed for rapid refueling of missiles. Unique air connection of nozzle permits significant misalignment of ports during Liquid Oxygen transfer without disturbing integrity of the male Poppet-type valve is operated by a plunger in the nozzle. Additional seal protection is provided by a bellows system which insures maintenance of seal and gaseous expansion or contraction of the assembly. Wide range of sizes are available to customer requirements.



Self-Sealing Nozzle and Adapters for H₂O₂

Designed for servicing missiles or missiles using Hydrogen Peroxide as an oxidizer, the nozzle features complete self-sealing. The nozzle must be manually locked before valve can be attached, and valve must be completely closed before connection can be disrupted. Uses a light weight and nozzle is protected by a bumper cone, to prevent damage. These components are available in sizes from 1/2 in. to 6 inches, with flow rates from 30 gpm to 1,000 gpm.



Versatile Quick Disconnect

Designed to handle wide range of fluids (oils, gases, and liquid metals), these units are specifically designed to meet present and anticipated special operations in a single Poppet-Block, Pull-to-Open. Both halves are self-sealing, and the unique locking system eliminates need for a separate safety device while providing protection against accidental disconnection during normal operation. QUICK-DISCONNECTS are designed to operate at pressures to 300 psi. and are available in sizes from 1/2 to 6 inches. Provision is made for remote control where such operation is desirable.

For specialized fuel system components to your specifications, contact Eagle Refueling, Inc. Many products are now immediately available.



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West Coast Representative: William E. Davis, P. O. Box 642, Agnew, Calif.
 Bay Area Representative: Fred E. Knecht, P. O. Box 523, Fort Mills, Calif.

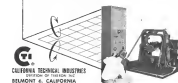
THREE-AXIS FLIGHT SIMULATOR

Providing a flight table which can be continuously oriented in space with respect to three mutually-perpendicular reference axes, the CTI Dynamic Flight Simulator can be programmed directly from the output of a computer. Operating smoothly with no jarring, the instrument example, independent velocity drops at each of the 3 axes and

converts these vector outputs into a position corresponding to the defined output vector.

By also reproducing the conditions of an actual high-performance aircraft or missile in flight, the simulator has capabilities of any laboratory.

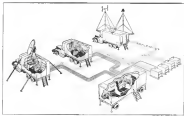
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Link Proposes ICBM Training Program

By George L. Christian



RADAR Signal Simulator (background above) simulates TM-61 system, it used in conjunction with guidance system trainer. Drawing below depicts Link's proposed jet engine trainer.



INSTRUCTOR PANEL, PILOT'S INSTRUMENT PANEL, IN-ENGINEER PANEL, COMPUTER DISPLAY, FLIGHT INSTRUMENT PANEL



LINK also is developing lightweight Fiberglas simulators for the commercial DC-8.

Richmond, N. Y.—Program to develop a comprehensive training weapons system for a sophisticated missile weapon system is under way at Link Aviation, Inc.

Link is preparing in the Martin Co., prime contractor of the Titan intercontinental ballistic missile, a method for setting up an integrated training program which runs the gamut of training devices from simple charts and film and classroom material to launch crop using means of starting wire and end-chutes and to develop complex electronic missile evaluation.

Present concept of the missile evaluation calls for device to produce within the ICBM almost all the features—and malfunctions, if desired—of the missile's launching and flight, including guidance, atmosphere effects and air threat threat.

Little Weapon

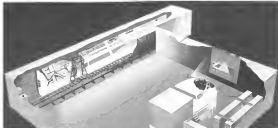
If Allan Wilford, Link president and general manager, told *American Week*, "Our integrated training system is in effect a little weapon system of its own, simulating all the basic systems and techniques involved in a potent weapon." He said Link system encompasses all the skills and techniques of the entire Titan system—its construction, preparation and use.

Officials point out that this area develops in a step-wise with the rapidly expanding missile segment of the aircraft industry parallel, rather than supercede work the firm has been doing for years in the field of piston and jet engine flight simulation.

Link has built some Radar Signal Simulators (RSS) for Martin TM-61 "A" and "C" type guided missiles. RSS units simulate missile firing, guidance and changing in conjunction with MQG-1A guidance system.

Link officials said that while the weapon system concept is fine for the prime product—such as an ICBM—the concept should not include training device for the weapon system. Rather they give the working training system to be bought as separate contracts in that division of know how and certain components could be common to most simulators if bought outside the framework of a weapon system. This results in more rapid development of training systems as needed at a lower overall cost, officials contend.

Link's proposal starts with the basic



CLOSED circuit TV camera (left) now vertically mounted side model of target, propels train across below, script simulates.

elements of missile launching and is fully integrated with the human factors aspects of the program, including Qualitative Personnel Requirements Information (QPRI) covered in *American Week* (Feb. 11, p. 78 and July 79, p. 66).

The program suggests taking as a dividend with certain basic skills, step-by-step the area in which he must be trained to become part of an integrated crew, then taking low step-by-step through the learning phase, first as an individual, then in a fully coordinated crew scenario.

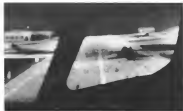
Varied Program

To accomplish this, Link's program goes through these actual steps:

- Helps determine feasible qualitative personnel requirements for the system.
- Examines numerous of human performance to be able to specify as early as possible the maximum number of independent man-hours and the specific characteristics of these man-hours. These will allow computer technicians to evaluate the reliability, stability and training effectiveness as function of the proposed training program and man-machine equipment.

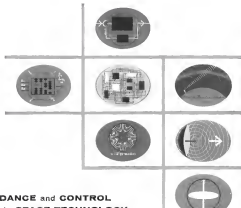
- Establishes training feedback, data which is an essential of any learning situation. Without it a student's performance either does not improve as a function of practice, or it only improves to a level which he can feel but not in adequate. Since the student's subjective level of attention was not approach the skill levels required for successful operation of a system as complex as the Titan, it is imperative that technicians determine the nature, content and timing of each feedback.

Link officials said that having



VIEW of simulated landing approach is shown above. Helicopter flight simulator is below.





GUIDANCE and CONTROL in SPACE TECHNOLOGY

It is becoming increasingly apparent that many of the techniques and analyses, and much of the equipment, developed for the present Air Force ICBM-IRBM programs will have a wide future application in space technology. For example, many of the guidance and control techniques for ICBMs are applicable to the space vehicle of the near future.

An important element of these applications is precision. The precision required of the guidance and control system for vehicles aimed at the moon or one of the planets is not substantially greater than that required for the Air Force ICBM-IRBM programs. And, the precision needed to guide a vehicle into a near-circular orbit of Earth is even less than that required for ICBMs.

The problems of communication with lunar and planetary vehicles is, of course, quite more difficult by the much greater distances involved. Thus, however, it is not an unmanageable difficulty if today's trends continue in the use of higher transmission power, narrower communication bandwidths and amplifiers with very low noise figures.

The problems of operating electronic equipment in the space beyond our atmosphere are already encountered on present ballistic missile trajectories. The principal difference in the case of space vehicle applications is the

requirement for longer equipment lifetimes. Electronic equipment and power supplies will have to last for several hours or days or weeks, instead of a few minutes, under conditions of vacuum, pressure, zero "g" fields, and bombardment by micrometeorites, high-energy particles, and radiation.

The preceding examples serve to illustrate some of the ways in which the ICBM-IRBM programs are advancing the latest techniques of space technology.

Since 1954, Space Technology Laboratories has been providing over-all systems engineering for these programs. Both in support of the responsibility and in anticipation of future system requirements, the Laboratory is presently engaged in a wide variety of advanced analytical and experimental work directed toward the exploration of new approaches in space vehicle electronics, propulsion, and structure.

The scope of STL's work requires a staff of unusual technical breadth and competence. Engineers and scientists who are interested in advanced experimental developments projects (as distinct from development for manufacturing), in which STL is not engaged, are invited to investigate the many opportunities at the Laboratory's Technical Staff.

SPACE TECHNOLOGY LABORATORIES

A Division of The Aero-Metallurgical Corporation

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and instruments and 103 flight instruments and effects going through transient training. It also includes additional personnel who would receive aerial training for 10 years. There are 17 ground service technicians and 100 aircraft, four maintenance base air mechanics and 20 flight instructors and officers.

The study concludes that one of a jet engine's most serious problems is a total loss of more than \$10,000. This figure does not take into consideration loss of revenue, that an engine could incur as a result of injury or accident

during engine operation or flight training, or loss of revenue, due to aircraft being assigned to training program.

E. A. Lark, chairman of the company's board of directors, created the first Lark Institute in 1929. A few years later, Lark Aviation, Inc., was founded. In 1954, Lark Aviation, Inc., became a subsidiary of General Precision Equipment Corp., which improved the firm's financial position with regard to capital and other needs, available the services of some 3,700 scientists, engineers and technicians working for GPEC's various subsidiaries.



TURBO-CAT aircraft launcher is powered by six Allison J33 turbine engines. Manufacturer, All American Engineering Co., says each engine is 30,000 hp in launching role.

Jet Launcher Proposed to SAC

New York—Strategic Air Command could cut five months from variable turn by using a jet-powered aircraft launcher on short dispersal fields. All American Engineering Co. officials said here recently.

All American's "Turbo-Cat" jet launchers and its water-sewer cable type launching gear (AW Sept. 23, p. 36) now is under evaluation by SAC for possible use in airports strong enough for, but too small for, B-52 and B-37 bombers.

Advocates of a complete standard budget request (AW Jan. 30, p. 38) declares \$2.5 million to expand and speed program for construction of SAC dispersal and alert facilities.

Charles W. Wrench, All American president, said overall cost of construction of launchers and launching gear would be \$2.5 million. The "Turbo-Cat," Wrench said, can put the B-52 bomber and four KC-135

tankers into the air in less than 15 min at a dispersal base where the longest runway is 5,000 ft. But aircraft can be off areas within 100 min at reasonable times.

"Turbo-Cat" is powered by six Allison J33 A16A jet engines, transmitting 30,000 hp to launching cable.

On landing, Wrench continued, the water-sewer launching gear can stop a bomber 2,000 ft. after touchdown, exerting with a 14 G force on the bomber. 500 hp can then be used to

test run at Georgetown, Del. Sea View County Airport, which Republic 1-44 and McDonnell F2H aircraft, flown by David P. McCullough, chief test pilot.

Safety features in system 600 launching gear, outlined by Raymond E. Jensen, II, chief engineer, "is entirely" dual system now in use on many military fields. He said plans today to skip, breaking rails and occasionally re-

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These men are needed in all phases of engineering activity—project engineering and design and the following fields:

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Kenneth T. Viall
Manager of
Engineering
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LINK **GPE**

LINK AVIATION, INC.
BIRMINGHAM, NEW YORK

handling aircraft. System 600 utilizes endless belt of rubber.

Conventional systems are "automatic" in the limited inboard and landing system according to Wood, but he said "one of the worst 'designs' has caused some lines to slip, for fear of adverse

passenger reaction." He recommended one of a host on an airline creating just action, but admitted "it will hang another 200 lb. on the system and that's a real problem." Wood backs his case, "because it's been proven over the years by the Navy."



RUBBER TIRE BAGS with a liquid capacity of 500 gal. each are pulled in sets of 30 by all-terrain Tractor. Fluid bags carry fuel, liquid chemicals or water.

Transporter Tows Fluid Fuel Bags

Ground fluid transporter that tows large rubber tire bags holding 500 gal. of liquid each in sets of 10 or more behind an all-terrain Tractor has been developed by the Four Wheel Drive Auto Co. for the Army's Transportation Research and Engineering Command.

Constructors for the Four Wheel Drive fluid transporter were developed by Goodrich Tire and Rubber Co. which also designed the yellow tow for the Tractor's tractor (AW Feb. 4, 1977 p. 35).

Current transporter can tow 5,000 gal. of fuel or other fluid in 10 500-gal. bags. Each contains which are 7 ft. high and 35 ft. wide.

Overseas tires are mounted to pins on special axles and towing assemblies equipped with idling, emptying and holding systems developed by Four Wheel Drive.

Actual capacity of the transporter is limited only by the pulling power of the towing vehicle.

Other than fuel, the rubber containers can be used to transport a variety of liquid chemicals, or water for fire fighting, according to Four Wheel Drive.

Filling and Emptying

A vehicle designed by Four Wheel Drive can fill or empty each container at a rate of 30 000 gpm. Units can be filled and emptied by gravity, pressure or vacuum systems. A filling system is provided for direct pumping of water back.

Rubber containers resist the effects of a range of chemicals and fuels up to 40% aqueous content, one has stored

in temperatures down to -60F and up to 360F and have operating temperatures down to -60F and 125F, the manufacturers said.

Goodrich units are designed on tubes for miles with wheel bearings and hub and rim assemblies that allow easy removal and replacement of single tire bags. They can be equipped with air or vacuum-over hydraulic breakers which are operated from the towing vehicle.

Terrain Capability

Four Wheel Drive says that by making the fluid containers their own mobile system, the transporter can move over terrain such as sand, mud, swamp, boulder, side slopes, hills and deep snow which would bog down conventional fuel-carrying vehicles.

Engine containers can be dropped by pneumatic full tanks have been dropped five feet without damage during desert exercises.

Four Wheel Drive has developed other transporters with capacities ranging from 140-1,000 gal. which may be towed singly or in tandem. Goodrich's single containers range in length from 36 1/2 ft. and in width from 34 1/2 ft. when full loaded.

Lubricant Withstands 600F Temperature

Extensive temperature tests with an operating range from -10F to 600F have been developed by Shell Oil Co. to meet the high temperature demands of supersonic aircraft and missiles.

Labeled grade XTR Grade B and

It the lubricant extends possible lubricating temperatures from 100F to 600F. Specifically, its high temperature performance, using ASFG rig (GRI 97) provides superior contrast, as revealed in a failure time of 104 hr. at 600F.

Shell says that in addition to high temperature range the new XTR class grades are water resistant, have very low evaporation rates and excellent air chemical stability. Company quotes three typical evaluations:

- Drop point: above 550F
- ASFG performance @ 77F: worked 65 strokes—512, worked 100,000 strokes—150
- Torque rate ratio (SAE 5-9C method) is 10-100/1000 at -40F 2.4.

At 410F bearing performance of the grease will surpass the 500 hr. tests now specified in MIL-G-25013, according to Shell. Company says that the lubricant has been field tested for the past two years.

Payroll Data Process Cuts Cost by \$1,500

A savings of over \$1,500 monthly in payroll accounting costs is reported by Minuteman Manufacturing Co. in processing the payroll of its Ft. Worth, Tex. plant. Costs were reduced the first year by having the Team build its plant complex 175 people at the manufacture of aircraft landing gear and guided missile components, with Minuteman's data processing center in Burbank. Utilizing International Business Machines equipment, including a data punch machine, card to tape converter and teleprinter, payroll data is transmitted daily to Burbank and at the end of the week the accumulated extensions are returned by wire to Ft. Worth in the form of checks. Elimination of manual accounting records and retention of central control of accounting are chief advantages of system.

Magnesium-Thorium Alloy Reduces Bomarc Weight

Magnesium-thorium alloy is being used by Boeing to reduce aircraft weight of the 7,500 lb. Bomarc arm aircraft missile. Selected areas of its light weight, stiffness and heat resistant, this material is used in sheet, extruded and cast form.

The alloy was magnesium-thorium alloy is 65% of the upper wing and down and 12 1/2% of the lower wing from upper and lower surface of the skin and doublers and the center fin and rudder skin and doublers. Boeing reports that the use of magnesium-thorium alloy obtained a potential savings. Earlier problems due to its high strength-weight ratio.

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USAF Secretaries Defend Budget Reins

Washington—Two top Air Force officials have spoken out in defense of the Administration's policy of keeping defense spending under tight reins.

USAF Secretary James H. Douglas admitted that in the past Special operations of our efforts to determine and control rates of expenditure for procurement were chaotic," and said "there are a few more," but he said "real benefits come out of this experience."

USAF Assistant Secretary for Material Douglas C. Sharp said "secretaries' restrictions . . . have had at least one great advantage—they tended to get the taxpayer more for his money, with no substantial loss of time."

Douglas said in a recent speech in New York that both USAF and its contractors "were better able to estimate the rate at which procurement contracts were spent" as a result of the spending ceilings.

These past efforts to hold down expenditures "resulted in very substantial savings that would not otherwise have been realized," Douglas said. "We are today better able to undertake high priority projects."

Secret Roman's intercontinental ballistic missile design and satellite launchers have raised general concern as to whether we have spent enough, in our spending enough, on defense," Douglas said, but he believes "the President and the Congress are alert to the danger."

'Not in Immediate Danger'

Douglas' own view is that "we are not in immediate danger today, but that dangers to our national security will increase tomorrow, and day after tomorrow, except as we do those things necessary to maintain an effective deterrent force."

U. S. and its allies together possess enough deterrent strength now, Douglas said. In heavy and medium jet bombers and fighters the U. S. is ahead, but "in the field of ballistic missiles and particularly satellites, we are somewhat behind the Soviets," Douglas said. "The Soviet missile development, coupled with its large fleet of submarines, constitutes a growing and increasing threat."

Roman's clanking of its most tal-

ented youth into engineering and the sciences "is the future of the Soviet threat that is perhaps the most serious," Douglas said.

Although the U. S. is strong enough today, the USAF secretary said, "we must be sure we are planning and strong in our effort to be one to maintain our deterrent power in the weapon of tomorrow and of the day after tomorrow."

USAF Steps

Some of the steps Douglas said USAF is taking to keep pace with advances in weapons technology are:

- "Maneuvers are not only supplementing but are replacing manned aircraft."
- USAF veterans including Chief of Staff Gen. Thomas D. White and Maj. Gen. Edward A. Schriener commander of the Bellview Missile Division, testified before the Senate Subcommittee Investigating Subcommunities recently that the Fiscal 1979 budget does not provide enough acceleration of intermediate and intermediate-range missile programs.
- Strategic Air Command is in the process of being strengthened by the



Petrel Powered by J44

Naval Petrel anti-submarine missile now out of production is shown for first time not suspended from aircraft. Anti-submarine missile developed by Lockheed is powered by J44 turbojet. Guidance system is radio homing.

conversion of B-56 wings to B-52s. This process is half completed."
- Air Force veterans, including Gen. Curtis LeMay, former SAC chief and now vice chief of staff, told the subcommittee that production of B-51 and KC-135 jet tankers will be too low. Fiscal 1979 budget includes an funds for increased or accelerated B-52 or KC-135 production.
- Increasing SAC's alert time. Testimony by USAF officers indicated they do not think the effort in this direction is not sufficient even with the funds provided in supplemental 1978 and Fiscal 1979 budgets.
- "The first of the response B-56 are being test flown and are meeting all expectations," Lt. Gen. Clarence S. Irvine, USAF deputy chief of staff, testified, testified that the B-56 is a "supersonic aircraft" that has been retarded by lack of funds at every stage of its life. First production funds for the B-56 are in the Fiscal 1979 budget.

Sharp Answers Criticisms

Sharp's answer to some of these criticisms:

- **Urgency.** Since "we cannot have all of everything that can be thought up, the degree of urgency attached to each item is a matter of judgment."
- Sharp cited the ballistic missile program as an example of evaluating proposals on a scale in the light of deterrent strength now and in the future. "The anti-submarine work was slowed in 1947 'partially be-

cause we had to test down the public's confidence in our military establishment, including the conviction that we lack a feeling of urgency that we flow fiscal limitations rather than defense needs to limit our military effort, that there is excessive waste and duplication of effort among other services, and that our procurement practices are frequently inept."

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cause we had to test down the public's confidence in our military establishment, including the conviction that we lack a feeling of urgency that we flow fiscal limitations rather than defense needs to limit our military effort, that there is excessive waste and duplication of effort among other services, and that our procurement practices are frequently inept."

• **Final business.** The statement that constant restrictions retarded missile efforts "simply is not so," Sharp commented.

Overline also was allowed on B-52 and KC-135s when it was necessary to maintain scheduling, he said. "It is true that we did not allow B-52 production to reach the higher rate that was once contemplated," Sharp said. "Admittedly, monetary considerations retarded the decision, but it was made primarily to get more rapid approval for greater spending power."

USAF proceeded with maneuver less aggressive in its tactical and air defense programs," Sharp said, but "substantive improvements, fighter bombers and anti-defense missiles" including Century Series aircraft and the B-56 were "never pushed at substantial rates."

Development of SAGE continued in an orderly fashion. It appeared correct to press forward at a rapid pace because of many complex technological problems that had to be solved," Sharp said.

Why Aircraft Shipments

Some of our aircraft shipments were shipped, largely for technical reasons," he stated, that it is sometimes better to "make haste slowly," he said.

"As a case in point, we could have produced one of our aircraft, the F-16, at a faster rate," Sharp said. "But per-



Lockheed Policy Committee Sees Nuclear Aircraft Cockpit Mockup

C. L. Johnson, Lockheed vice president-engineering and research, examines mockup in meeting of nuclear aircraft crew compartment (left) at Lockheed's General Electric, Morris, Co. At right, Bill Hildner, Lockheed senior vice president (left) from left, explains Johnson's machine on TV. Equipment is in human factors laboratory, used to check factors involved by crew on theoretical fire-fight

Solid Potential

Washington—Development of solid propellants will permit installation of medium-range ballistic missiles from ground vehicles and should add an important new offensive weapon to our forces," according to USAF Secretary James H. Douglas.

Douglas also says Atlas and Titan intercontinental missile boosters equipped with stages added, can provide propellant for the launching of relatively large satellites and permit exploration beyond our satellite, the Moon.

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rate-gift to provide two unidirectional
output speeds from a single-
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vide precise control settings.

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operated correctly at altitudes below 5,000
ft. coupled with the indication of the
significance of the static system based
after impact indicates clearly that these
instruments could not have of themselves
produced erroneous readings which could
have contributed to the accident.

The probability of an error in attitude
being introduced by a malfunction of water
in the static system was also considered.
In this connection, it must be noted that
the static system is immune to both
the upward and inward shock conditions,
as well as to the situation. Any effect
on the altimeter would be accompanied by
a similar effect on the upward attitude
indicator. The captain's and first officer's
primary instruments are served by separate
and independent static systems.

No Instrument Malfunction

It was established that it would be
extremely rare to have a considerable amount
of water accumulated in the static system
to produce an error in attitude indication
of a magnitude necessary to have caused
the accident. Moreover, this relatively
large quantity of water would have caused
rapid subsidence much higher than ac-
tual. It is possible that the pilot would
not have properly diagnosed these errors
during the approach, however he should
have been alerted by the fact that some-
thing was wrong. Since he realized that
the reported indications were correct
throughout the approach and descent, it
is apparent that an altitude error of this
magnitude would not have been
present. In an event because of the dis-
crepancy of static systems, it is extremely
unlikely that an error in one system would
overrule the same time and with the same
magnitude in the other system. According
to American Airlines, the static system
data available are derived at each periodic
check scheduled at periods not greater
than 125 ft. The data show immediately
on this record were checked every five
feet prior to the accident. A review of the
cockpit history of American Airlines' Cen-
tury 740 which indicates no unusual
approach characteristics of these static
system. These records also reflect that the
static system compares favorably with the
static systems of other aircraft in the
company fleet. The Board therefore concludes
that dynamic malfunctions of such a mag-
nitude strong from water as the static
systems are remote and improbable and
that the possibility can be eliminated.

It is worthy to note that this was the
first time Capt. Verna and First Officer
Johnson had flown together and that it
was also First Officer Johnson's first solo
cockpit approach into Tulsa. This is not
unusual in itself. First Officer Johnson
was a pilot in instrument flying but rather
that his degree of proficiency was in reference
to Capt. Verna and therefore, the ap-
proach, being made under night conditions
during adverse conditions should have
been associated with the standard crew.

Another factor that must be carefully
analyzed is the weather and what possible
effect it may have had on the captain's
judgment. The company meteorologist at
Chicago briefed the crew of Flight 007,
prior to departure, on the possible on-
coming and forecast weather conditions and

Performance Data Recorded on-Board



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They offer unusual combinations of properties for missile and aircraft parts

In designing structures that meet the severe demands of jet and rocket propulsion at supersonic speeds, special Armco Stainless Steels offer major advantages. They not only provide high strength over a wide temperature range, but other mechanical properties and characteristics make them especially useful for aerospace structures, power plants and accessories.

Here are a few basic facts on eight Armco-developed stainless steels that illustrate their potential in aircraft design.

Armco PH 15-7 Mo—The newest of Armco's revolutionary precipitation-hardening stainless steels. Offers excellent fabricating qualities, sheet with a guaranteed F_u of 215,000 psi in Cond. KH 990, and exceptionally high strength-weight ratios up to 3000 F. Conventionally available in all forms, PH 15-7 Mo provides unusual design advantages for critical parts of both missiles and aircraft.

Armco 17-7 PH, 17-4 PH—Precipitation-hardening grades that are being widely used for missiles and aircraft. Both grades offer high strength-weight ratios at temperatures up to 900 F, excellent fabricating characteristics and require only single heat treatment. 17-7 PH is available in sheet, plate, strip, bar, wire and hollow; 17-4 PH in bar, wire and hollow.

Armco 17-10 P—A special non-magnetic, precipitation-hardening grade. It offers higher mechanical properties than standard non-magnetic grades. Useful for instrument parts, accessories and other applications that call for the unusual combination of characteristics. Available in the form of bar, wire and hollow.

Armco 17-14 Cu Mo—An Armco Stainless Steel that offers high, long-time creep strength in service up to 1500 F. Good room temperature mechanical properties are relatively unaffected by long-time exposure to elevated temperatures. Can be readily worked hot or cold, has good

weldability and machinability. Produced in sheet, strip, plate, bar, wire and hollow.

Armco 22-4-9—This austenitic stainless, containing chromium, nickel and manganese, is processed to resist high strength and hardness up to 1600 F. Short-time ultimate tensile strength ranges from 114,000 psi at 900 F to 58,000 psi at 1600 F. High temperature hardness resists wear, erosion and galling. Available in bar and hollow.

Armco Ferrite-Free Type 431—Special Armco Precipitation hardening Type 431 that is consistently free of ferrite. Eliminates all ferrite banding, improves ductility, assures uniform properties and increased ductility in the transverse direction. Ideal for high-strength, corrosion-resistant forgings. Produced in bar, wire and hollow.

Armco Modified 12-Chromium Grades—Armco modifications of 12-chromium stainless that offer room temperature ultimate tensile strengths in the range of 115,000 to 215,000 psi. Have good mechanical properties up to 2200 F and retain softening at elevated temperatures. Produced in bar, wire and hollow.

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Compressors for new Convair wind tunnel for testing designs to Mach 5



First stage Allis-Chalmers 17,000 cfm three-stage compressor driven by an 800 hp Allis-Chalmers motor

Uses combination of Allis-Chalmers compressors, motors, switchgear, control

Convair's new high speed wind tunnel is a blow-down, axial-flow design type. This design was chosen because of its compressive capability and because it requires only a fraction of the horsepower of continuous flow tunnels.

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Allis-Chalmers. Equipment supplied by A-C includes main, centrifugal and rotary compressors, and over 400,000 hp in electric motors, plus transformers, control and switchgear.

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Allis-Chalmers has supplied compressors and control for power distribution and protection

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his expected determination of the weather at Tulsa about 2100. When the flight was started during the early part of the flight, the low frequency range. Tulsa approach control gave the 2515 Tulsa weather as: Visual ceiling 600 ft, correct visibility 1 1/2 mi, light clouds and light wind, calm. A short time later the flight was advised that the weather was leaving and that the U. S. Weather Bureau was checking the ceiling. Notwithstanding the fact that the weather was leaving and that it did not have the latest ceiling check, Capt. Mann continued the approach, apparently assuming that the latest ceiling report of 600 ft would hold.

Whether the captain, because of his last ceiling report, had a feeling of false security or not is known. It is true, however, that with his knowledge that the visibility had actually increased threefold in a mile in a few minutes, coupled with his knowledge of the company's limited fuel, he should have reported the ceiling flow to his first officer previously at 600 ft. This is an obvious safety issue and it was obligatory that the captain report the approach to descend below the reported minimum altitude.

Altimeter Policy

As has been stated, it is American Air Lines policy to let the captain's altimeter be the primary and the first officer's altimeter be the secondary altimeter. In cases where the altimeters are not in agreement, the captain's altimeter is to be used. This policy was followed in this case.

Capt. Mann further testified that the descent to Tulsa began at an altitude of 3,500 ft and that he told the first officer he would descend to an altitude of 700 ft by going down 1,000 ft in 10 seconds. In the event, he made no reference to which altimeter should be used. Since the first officer's altimeter was not in such a low altitude, it is a matter of 700 ft, as the altimeter would have placed the aircraft at or near ground level.

The descent from an altitude of 3,500 ft was begun at 2110 and the altimeter was set at 2001 feet. Approximately 10 seconds elapsed from the start of the descent to the ground. The altimeter of the first officer at the time of the accident was 610 ft and the altimeter descended 1,850 ft at an average rate of 71 ft per second. The altimeter of the second officer at the time of the accident was 610 ft and the altimeter descended 1,850 ft at an average rate of 71 ft per second. The altimeter of the first officer at the time of the accident was 610 ft and the altimeter descended 1,850 ft at an average rate of 71 ft per second.

This average rate of descent strongly suggests that the captain advised a rate of descent of 1,000 ft per second. The altimeter of the first officer at the time of the accident was 610 ft and the altimeter descended 1,850 ft at an average rate of 71 ft per second. The altimeter of the second officer at the time of the accident was 610 ft and the altimeter descended 1,850 ft at an average rate of 71 ft per second.

and about 2110, was after the flight was started. The thought that the altimeter was not in such a low altitude may have led Capt. Mann to believe he had some 800 ft to go to descend before reaching his minimum altitude and that this was a reasonable time to report the descent to the tower. The fact that the altimeter was not in such a low altitude at the time of the accident is a matter of 700 ft, as the altimeter would have placed the aircraft at or near ground level.

FINDINGS

On the basis of all available evidence, the Board finds that:
1. The captain, the altimeter and the crew were properly qualified.
2. The flight was in accordance with the minimum altitude and the load was properly secured.

3. The flight from Tulsa to Tulsa was made in accordance with the minimum altitude.

4. The flight was the first time the captain and first officer had a flight in together.

5. The flight after the altimeter was set at 2001 feet and the altimeter was set at 2001 feet.

6. The altimeter and the altimeter were checked throughout the flight and approach.

7. The altimeter report received by the first officer was in accordance with the altimeter report received by the first officer.

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the route described in the report.

Capt. Wesley G. Adams, age 35, was employed by the company on Mar. 8, 1945. He held a currently effective aviation certificate with ratings of engine, transport pilot, single and multi-engine land, Category and DC-6/550. He had 9,677 flying hr. with approximately 4,180 hr. in C-54s. Adams said the last C-54 fire-line physical occurred on Oct. 24, 1956, without incident.

First Officer Paul H. Johnson, age 36, was employed by the company on Jan. 26, 1948. He held a currently effective aviation certificate with ratings of transport pilot, engine, and single and multi-engine land. He had a total of 7,170 flying hr. of which 521 were in C-54s aircraft. His last in-

strument check was taken on Oct. 15, 1955, and his last line check was taken on Jan. 2, 1957. He proved his last line check, CAA physical examination on Jan. 29, 1958, at a local station.

Sheila D. W. (Liz) age 25, was employed by the company on May 12, 1957.

The Aircraft

N 942C, a Cessna model 240B and number 104, owned by American Airlines Inc. was constructed Oct. 7, 1945. First flight time on this aircraft was 11,642 hr. It was equipped with two Pratt & Whitney R2600-13A105 engines and Hamilton Standard model 48-50 propellers. Both engines have and propeller have been under CAA approval since.

Pan Am Crash Cause Still Is Undetermined

San Francisco—Civil Aeronautics Board hearing on crash of a Pan American jetliner in the Pacific Nov. 5 failed to answer one factor that would explain why the plane went down and why the crew was not able, before the crash, to send a distress message on one of the plane's four radio sets.

Three theories emerged from the hearing.

- That the turbine in a turbo supercharger might have disintegrated, forcing fragments through the craft.
- That carbon monoxide, found in the bodies recovered, might provide a clue to the crash.
- That a hard noise heard in the plane during a Sept. 19 flight might mean something was wrong with the airplane.

A pathologist testified that elevated levels of carbon monoxide were found in the victims (bodies of 10 of the 44 killed were recovered). Whether that is significant, or whether it is due to decompression of the bodies, can be answered only after further research, he said.

Wreckage of the plane showed no signs of damage that would substantiate the turbo supercharger theory, it was testified, but it is a theory that might explain the main failure and the radio crash. However, Pan American witnesses testified that in the few radio failures that have occurred the fog signals escaped through the exhaust stack, without doing appreciable damage, in the plane.

Pan American witnesses said they examined the plane thoroughly after the crash was reported on the Sept. 19 flight and found nothing to indicate it was caused by a mechanical defect.

In the case, the eight-member investigation panel headed by Robert W. Chapin heard a total of three cases that dealt with the crash. Among them:

- Weather. It was good.
- Sabotage. The 98 persons who had contact with the plane before it crashed were interviewed and nothing was found to indicate sabotage.
- Maintenance. The engine.
- Fuel. Examination of the chemical wreckage showed it burned after, not before the crash. Only one engine part was recovered—oil-pressure ring from an engine—and tests asked out a few in that engine.
- Propeller malfunction. They were solid dual-type and experienced with their use here good.
- Fuel pump explosion.
- Fuel pipe.
- Cargo. Two items were suspect—a radioactive material and sodium sulfide.

used at for 1,000 hours—that's the one that goes back on your engine. Under the worst shop systems, you could end up with a 9,000 hour part and a top bell seat time. Making parts that have "wear in" are essential. And, you get individual treatment of the operating problem down by the internal condition of your engine at overhaul. Only Airwork offers this individualized overhaul method... the best you can get anywhere.

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REPORT FROM RYAN

Ryan's Diversification Creates Wide Opportunity for Engineers



More Orders for Ryan Firebees

San Diego—Nearly 370 million worth of Ryan Firebee jet drone missiles have been ordered by the Air Force and Navy in 1957. In operational use, the Firebee is the nation's most reliable "enemy" target for enhancing the performance of air in our and ground-to-air weapons. It possesses the high speed, altitude, maneuverability and extended duration needed to simulate "enemy" intercept problems.

America's number-one jet drone, the Firebee is another example of Ryan's skill in blending modernity, jet gas turbines and extensive knowledge to meet a challenging problem—answer a vital military need.

X-13 Vertijet Adds New Punch to Airpower

Washington—Crowned as an unprecedented flight at the Pentagon, the Ryan X-13 Vertijet gave military officials a glimpse of the future of supersonic. Later a large had, the Vertijet unhooked itself from its nose cable, hovered vertically, then whipped over into horizontal flight and zoomed out of sight.

World's first jet VTOL aircraft, the Vertijet combines the striking performance of jet power with the stability of guided launching. It fires expensive airpower from runways and airports. Without landing gear, legs, skids, the X-13 concept seems less weight—more performance in speed and climb.

In the words of a top Air Force General, "The Vertijet has provided military planners with a new capability for assured accuracy at all distances." Achieved in close cooperation with the Air Force and Navy, the Vertijet is based upon Ryan's unsurpassed 75

million man-hours of research, development, and test in VTOL aircraft.

Navy, Army to Use New Ryan Navigator

San Diego—Navy aircraft—jet gas engines, jets and helicopters will soon be equipped with Ryan lightweight automatic navigators and ground velocity indicators. Lightest, simplest, most reliable, most compact of their type, these systems are self-contained and based on continuous wave radar.

The navigators provide pilots with required data such as latitude, longitude, ground speed and track, drift angle, wind speed and direction, ground miles covered and course and distance to destination. Ryan is also developing guidance systems for supercruise missiles.

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Resistance Welding of Jet Engines

Pratt & Whitney Uses Sciaky Techniques To Slash Weight of J-57 Engines

The replacement of sheet metal steel with Sciaky resistance welded sheet steel has made possible a significant weight reduction in Pratt & Whitney Aircraft's J-57 jet engine.

The part affected is the dorsal stator of the compressor section. Before the large Sciaky welders were put into service, the dorsal stators were made of steel, fabricated with a sheet lasing process.

As a result at Pratt & Whitney's constant research for improvement, project engineers recommended the use of sheet metal. Experiments showed that resistance welding, under the 7500-pound pressure delivered by the Sciaky machines, was the only means by which the sheet metal pieces could be joined without weldment cracks.

Five Sciaky patented Three-Phase

welders producing a total of 740-800 secondary amperes used for this operation represent the largest concentration of such machines in the world. They are described by Pratt & Whitney Aircraft as the only welders capable of satisfactorily welding the aluminum sheets.

Three of the five welders are equipped with Sciaky Protonatron Electronic Control Controls. The engine control order it possible for them to get precisely what they set on the machine. There is no vibration and set-ups are consistent through the entire range of adjustment. Set-up to repeat process runs is simple.

For further information, write today for Bulletin No. 228 and 229. Sciaky Bros., Inc., 4935 W. 47th St., Chicago 30, Ill., PO Box 7-1586.



HELPS PUT PROFIT INTO MANUFACTURING



Clearance of the dorsal stator before resistance welding.

Four heavy patented Three-Phase welders installed in the East Hartford plant of Pratt & Whitney Aircraft. Since the photo was taken, a fifth machine has been added. They are the only welders capable of welding aluminum sheets without lasing cracks.



disagreement if unity, but the voters showed no sign of being swayed by them.

The investigation hearing was held in San Francisco.

TAA Plans to Change Viscount Landing Gear

Melbourne—Trans Australia Airlines has decided on an extensive program of modifications on its Viscount Viscount fleet to enable the airline to use several secondary airports as well as to operate more successfully on the long East Coast West Coast route. The program is expected to be completed in 1970.

Two of the 736 series aircraft will be modified to allow payload to be increased to about 1,200 lb and jet engines changed from 34 to 40 on the long Adelaide-Perth and TAA's 17th and 18th Viscounts, due for delivery in 1970, will have both landing gear and longitudinal modifications incorporated during manufacture.

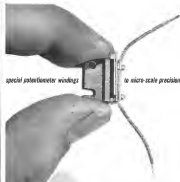
Landing gear modifications have been ordered for the entire Viscount Viscount fleet. The change which Viscount's high-line pressure inflators on runway surfaces was giving TAA into constant trouble with Department of Civil Aviation which progressively restricted Viscount operations to only major airports. The landing gear modification was ordered despite high costs involved to reduce the tire pressure from 110 to 85 psi. Automatic landing aids will be added to Viscounts.

For the long Adelaide-Perth run, where the Viscount found it difficult to compete with DC-6 and DC-8B air craft, the longitudinal modifications will be extensive and will include a ground strengthening of structural fuselage unit. It is estimated that at least 5,000 man-hours will have to be devoted to each aircraft. Even then the Viscount will be handicapped, to offer satisfactory service on this route and TAA is urging the purchase of Caravelle Viscounts or Lockheed Electras for this long route.

Six of TAA's 736 Viscounts will be converted to 750 series, giving the older model an extra 13 mph and an extra 1,000 lb payload. New engine order combinations have also been ordered.

Fiat to Begin Overhauling of NATO F-86 Fighters

Fiat Motor Co. will be a major contractor for NATO F-86 fighters. About 60 aircraft are involved in the first batch to be turned over to Fiat for overhaul. U.S. designated company, and agreed to provide Fiat with several million dollars worth of special equipment necessary for the work.



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French Navy Vertol Releases Bomb Load

French Navy's Superpuma SF-604, has ejected a bomb rack underneath a Vertol SF-604 helicopter for use in combat operations against rebel forces in Algeria (AVW Jan. 6, p. 26). Lt. E. Babet, commander of the Superpuma, released the rack beneath the forward belly door. He sees the helicopter's auxiliary fuel tank arrangement as a dropping mechanism. Above, the rack everts five bombs. Below, four practice bombs are dropped in silhouette. The 250-lb. bombs in two rows of five have been mounted and equipped with proximity fuses. The bombs can be dropped individually or in salvo. Bomb-throwing arrangement is at cockpit.



Changes

(Continued from p. 21)

Donald Richardson, medical manager, Air Research Aviation Stores, Division, The Garrett Corp., Los Angeles, Calif.

Edgar H. Sefton, sales, representing sales mgr., Chicago North Industries Inc., Milwaukee, Wis. Will K. Sefton succeeds him as manager of the company's Division, Chicago office.

John F. Chilton, West Coast sales mgr., Road Instrument Division Co., Los Angeles, Calif.

Henry M. Wade, commercial products marketing manager, Lutz, Inc., Santa Monica, Calif.

Garth A. Wolfenstein, consulting engineering system architect, Upstream Products Department, General Electric Co., Syracuse, N. Y.

William F. Wenzel, standards engineer, and **W. Marshall Yousens**, chief draftsman, Commercial Division of Pratt & Whitney Co., West Hartford, Conn.

Col. Frank J. Shannon (USAF), military manager, Federal Bell Corp., Portland, Ore.

W. M. Gillette, manager, Service and Repair Division, Republic Aircraft Manufacturing Co., Downers Grove, Ill.

Henry J. Hines, western sales manager, Communications Division, Teleg. Sales Bureau Co., Los Angeles, Calif.

Thomas H. Ray, marketing manager, Fairchild Semiconductor Corp., Palo Alto.

John M. Spinkman, military marketing manager, Vaco, Inc., De Mont Laboratoire, Los Angeles, N. Y.

Charles G. McMillan, director of engineering production products, Bendix Radio Division, Bendix Aviation Corp., Tucson, Ariz.

Earl Hawkins, public relations manager, Federal Eagle Division, Federal Engine and Turbine Corp., Elms Park, N. Y.

Norris Harrison, western sales, Los Angeles, Calif., has appointed two managers of subsidiaries and subsidiaries: **Frank W. Ward** for the WS-110 program and **W. H. Van May** for the WS-210 program. (See Feb. 1967, p. 21)

Marion Knuts, director of engineering, Tires Division, Division, Bendix Aviation Corp., Allentown, Pa.

Edward F. McDonough, operations control analyst, Lockheed Department, Division, Lockheed, Division of United Aircraft Corp., Thousand Oaks, Calif.

Ed Trumpette, West Coast sales and engineering representative, (Garrett Park, Calif.) Spence-Clark Co., Division of Vaco Corporation of America, Biber, Germany.

John D. Kallier, marketing manager aircraft and standard sales, Flexible Tubing Corp., Cudahy, Wis.

Nathan C. Sutter, manager, West Coast office, (California, Calif.) Southern Bell, West Corp., Thompson, N. Y.

K. F. Cason, deputy chief engineer, Service Division, English Electric Co., Ltd., Lancaster, England. (See B. D. Hardy, chief project engineer, E. London, chief avionics engineer, F. E. Inc., chief development engineer, J. C. King, branch the Division's research chief engineer, has joined the company's Directorate of Engineering in London.)



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AVIATION WEEK, February 2, 1958

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ELECTRA UNDERWAY ON FLIGHT PROGRAM. Continuing ahead of schedule in all phases of production and flight, the new Lockheed Electra is already logging flight hours prior to the official start of CAA certification tests. Powered by four Allison 501 Prop-Jet Engines and Aero products 606 Turbo-Propellers — CAA approved several months ago — this luxurious new passenger transport is America's jet-age answer to medium- and short-distance airline routes. Scheduled to enter commercial service late this year, the Prop-Jet Electra will bring jet-age comfort at cruising speeds of more than 400 miles per hour to air travelers everywhere—will bring new operating economy to the airlines of the world.



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